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Institutional Change in the Non-Market Economy: Endogenous Matching in Chennai's Chit Fund Auctions*

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Abstract

This paper tests the proposition that non-market institutions can respond flexibly to changes in the economic environment that they operate in, using data from Chennai's chit fund auctions. These auctions bring borrowers and lenders together in small groups, and starting from September 1993, legal restrictions exogenously capped the amount that could be bid in the auctions. A theory of endogenous matching is proposed, in which borrowers and lenders sort themselves into groups with different characteristics, which also predicts how the participants will re-sort following the policy experiment. Data collected before and after the experiment reveals that this non-market institution settles remarkably quickly into its new equilibrium. Consistent with the theory, a completely different composition of borrowers and lenders in the groups, and a completely different group structure is observed.

Keywords. Roscas. Non-market Institutions. Endogenous Matching. Financial Intermediation.
JEL. O12. O17. G20. D40.

1 Introduction

The importance and the persistence of non-market institutions in developing economies has generated a great deal of interest among economists in recent years. While the analysis of comparative agrarian institutions, notably sharecropping, has a long history in the economics literature, this line of research has been extended over the last decade to rotating savings and credit associations (Besley,

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Coate and Loury 1993, 1994), cooperatives (Banerjee, Besley and Guinnane 1995), mutual insurance arrangements (Townsend 1994), and informal credit institutions (Udry 1994). The prevailing view in this research is that non-market institutions are opportunistic arrangements that exploit social ties to overcome information, enforcement, and coordination problems. Despite their obvious inefficiencies, these institutions may still do better than their competitors when market institutions function imperfectly. In this view, non-market institutions should not be seen as vestiges of a traditional economy, dominated by social ties and reciprocal exchange, that essentially hinder change. Instead, these institutions may actually play an active role in the transition from the traditional economy to the modern market economy. As a policy recommendation, this suggests that non-market institutions should be encouraged, or at the very least left alone, instead of being discouraged and strictly regulated as has been the case in many developing economies.

The optimistic assessment of non-market institutions that we have just described relies on the idea that these institutions will alter their structure, or be replaced by more appropriate institutions, as the economic environment changes over the course of the development process. But there has been little empirical work that studies how different non-market institutions respond to changes in the economic environment that they operate in.[1] Non-market institutions often use social sanctions to ensure that individuals do not deviate from cooperative patterns of behavior, and such social regulation may leave these institutions relatively unresponsive to change. Consistent with this view, social regulation surrounding marriage and fertility has been documented to be remarkably rigid in traditional societies (see, for example, Munshi and Myaux 2002).

Our position in this paper is that this rigidity is not a feature of non-market institutions *per se*, but a consequence of the restrictions that sometimes keep them in place. The importance of social regulation will decline as these institutions evolve, and we would expect to see a corresponding improvement in their flexibility. We test this view by studying a classic non-market institution, which has evolved to the point where it displays several features, such as relative anonymity and competition, that are associated with the market. As expected, we will see this particular institution respond swiftly and appropriately to an exogenous economic change.

The subject of this paper is the rotating savings and credit association (Rosca). Roscas are informal financial institutions, which are popular throughout the developing world, and are even found among migrant groups in the U.S. and other advanced economies. In its traditional form, the Rosca consists of a small group of individuals with social ties to each other who contribute a fixed amount of money to a "pot," at fixed intervals of time. The amount in the pot is disbursed in each period, either by lot or by auction, and each participant in the Rosca receives the pot once only. In its simplest form, as analyzed by Besley, Coate and Loury (1993, 1994), the Rosca facilitates the consumption of consumer durables. For example, imagine that ten residents of a village get together

[1] Previous empirical work on non-market institutions has typically taken a static approach to analyze the structure and the performance of these institutions (as in Udry 1994, Banerjee et al. 2001).

to save ten dollars each every month. They are all interested in purchasing a bicycle, which costs one hundred dollars. If each individual saved independently it would take him ten months to buy the bicycle. With the random Rosca, one member of the group drawn at random receives the bicycle in each month, starting from the first month, so everyone is at least as well off as they would be in autarky. Once a participant has won the pot, he must still continue to contribute his share in each period until every member of the group has received the pot, so social ties play an important role in ensuring that the Rosca participants do not renege on their institutional obligations.

Turning to the setting of this paper, while simple Roscas have been popular for centuries in rural South India, the institution that we study in this paper is based in the city. The Indian banking system was nationalized in the early 1970s, and the urban Roscas, or *chit funds* as they are known in South India, emerged shortly after nationalization. Chit funds apparently took advantage of a legal loop-hole that allowed them to function as financial intermediaries, in competition with the banks, as long as their organizational structure precisely matched the basic structure of the simple Roscas described above. What distinguishes the urban chit funds from their rural predecessors is that members of a group have no direct social ties to each other. Large companies bring thousands of participants together into these small groups, and the organizers, in exchange for a participation fee, are responsible for any defaults that may occur. Moreover, the pot is now dispersed through an auction (often an English auction) in each period. The bid amount is distributed equally among all the members of the group as a "dividend". This process continues, with a fresh auction in each period, until all the participants have received the pot once – there is of course no auction and no dividend in the final period.

Although the participants in the urban chit funds may not know each other personally, there is still a social aspect to the institution. Chit funds have been popular in rural South India for centuries, and so it is not surprising that the urban version of this traditional institution is almost entirely restricted to centers in South India, where participants understand how the game is played and where some level of trust can be sustained even in the city. Indeed, while the company that provided us with the data has organized a few groups as far away as Mumbai, on the western coast of India, and even in Edison, New Jersey, such forays are always restricted to the expatriate Tamil community. The institution that we study in this paper is very much a non-market institution.

While the simple Rosca is a savings mechanism that typically brings together individuals with similar characteristics, the urban chit fund acts as a financial intermediary, matching borrowers and lenders. The dividend that is generated endogenously within a group acts as the interest payment. Participants who win the pot early are effectively borrowers, while those who wait until the end are effectively lenders – the participant who wins last receives his principal in return for all the dividends generated over the course of the chit fund. The dividend thus reflects the competitive price of capital within the group, and it is consequently not at all surprising that the chit funds generate an interest rate that is at least 3-4 percentage points higher than what could be obtained by depositing capital in

the monopsonistic banking system (James Raj Commission Report 1975).[2] Businesses, and borrowers in general, also benefit from this institution, since credit is so severely rationed by the banks.

Not surprisingly, chit funds have captured a substantial share of the credit market over time. Starting with almost no registered companies in the 1970s, deposits in *registered* chit funds were estimated to be roughly 10% of the volume of bank deposits in the South Indian state of Tamil Nadu by 1993 (Bouman 1995), and 15% of the deposits in the neighboring state of Kerala (where chit funds play a more prominent role in the local economy) in 1987 (Shah and Johnson 1989). The same sources report that the amount of credit made available by the chit fund companies was 12.5% of bank credit in Tamil Nadu and 25% of the credit in Kerala.[3] Chit funds clearly provide serious competition to the banking system, at least in South India, where they are most prevalent.

As discussed in Section 2, government regulators and the Reserve Bank of India (RBI) were quick to notice the emerging popularity of this non-market institution. RBI reports from as early as the 1970s explicitly identify chit funds as direct competitors to the banking system, and take note of the higher interest rates that these institutions could provide. Efforts to regulate the chit funds ultimately led to the passing of the Chit Fund Act by the Indian parliament in 1982, which set down strict guidelines uniformly regulating the functioning of this institution throughout the country. For our purpose, the most significant feature of the Chit Fund Act was the imposition of a 30% ceiling on the bids – continuing with our simple example, this says that the maximum bid for the one hundred dollar pot could not exceed thirty dollars. This restriction effectively capped the interest rate that the chit funds could generate, narrowing their comparative advantage over the banks. Not surprisingly, the chit fund companies went to court, seeking to overturn the imposition of the 30% ceiling. They were successful initially, winning a stay order from the Madras High Court in 1983. But the case slowly wound its way through the Indian judicial system, and the 1982 Chit Fund Act was ultimately upheld in its entirety by the Supreme Court in September 1993.

The imposition of the 30% ceiling in 1993, eleven years after the passing of the Chit Fund Act, provides an exogenous institution-specific shock, which we will exploit in the empirical analysis. Our objective will be to study how the structure of the institution responded to this exogenous change in the economic environment. The data that we use for the analysis is obtained from a single chit fund

[2]There are obvious inefficiencies associated with the chit fund - trade is restricted within the group and the opportunities for inter-temporal substitution are severely limited. These inefficiencies are unavoidable since the chit funds must adhere to a precise organizational structure, as specified by law, in order to be allowed to function. Yet, they appear to compete very effectively with the banking system; the interest rate calculations that we report later in this paper suggest that the difference in interest rates between chit funds and the nationalized banks could be as high as 9 percentage points.

[3]Statistics from the references cited above are combined with banking statistics from Reserve Bank of India documents to compute these numbers. There is little doubt that these statistics substantially underestimate the importance of this non-market institution in the local economy, since they do not account for the myriad unregistered chit funds, organized along the same lines, in these states.

company, one of the largest in the country, with branches in multiple South Indian states. The data set provides the value of the bid paid by the winner in each period in all the groups that commenced in the city of Chennai (formerly known as Madras) from September 1992 to September 1994 - one year before and one year after the policy shock. Chennai is the business and financial center of the South Indian regional economy, and this one company runs as many as 20 neighborhood branches in the city.

The chit fund company offers a menu of groups, with different durations and chit values (pot sizes) for potential participants to choose from. Individual participants join independently, and once a group is formed, the auction occurs every month. As noted earlier, the chit fund essentially brings together borrowers and lenders. In this application, it is easy to single out borrowers, since the organizing company privately records whether a participant is a "corporate subscriber". These subscribers, who account for roughly 20% of all participants, are financial companies who tend to win the auction on average much earlier than the "individual subscribers." This is consistent with the view that they are net borrowers, and we will therefore treat the corporate subscribers as borrowers and the individual subscribers as lenders in the empirical analysis.

Later in Section 3 we will present a simple model of the chit fund with two types (borrowers and lenders), which is solved in two stages. In the first stage, chit fund participants *endogenously match* by choosing from a menu of funds of different durations, offered by the chit fund organizer. The first stage equilibrium strategy determines the proportion of borrowers and lenders in the different funds that are offered. In the second stage, the auction is executed in which the pattern of equilibrium bids determines the expected payoff, for a given proportion of borrowers and lenders.

Based on the equilibrium expected payoff of the auction, the proportion of borrowers acts as a Walrasian "price" in this institution, adjusting to leave each agent indifferent between the various types of chit funds in equilibrium. Without a participation price for each auction to guide them, individuals use the composition of borrowers and lenders in each type of group to arrive at the decentralized equilibrium. This endogenous matching is a novel contribution to the auction literature[4], and in addition, it provides the following main predictions: First, the proportion of borrowers, as a result of the equilibrium matching, will vary systematically with the duration of the group. Second, the *change* in the proportion of borrowers following the policy experiment will depend on the extent to which bids were capped by the 30% ceiling.

This is precisely what we observe in the data in Section 4. The proportion of borrowers is declining in the duration of the group in the unconstrained equilibrium (prior to the bid-cap), across the range of pot values. The proportion of borrowers also increases disproportionately after the policy experiment in the long duration groups, which were capped most severely, as predicted by the theory. Remember that participants join independently, and so do not observe any signals about the attractiveness of

[4]Endogenous matching has recently received more attention. In an interesting paper, Ackerberg and Botticini (2002) analyze the impact of matching on contracts.

long or short duration funds *ex ante*. Their matching decisions are merely based on their beliefs about other participants' decisions, and it is thus quite remarkable that participants respond so sharply to the change in the economic environment in this non-market institution.

We complete the empirical analysis in Section 5 by studying the change in the structure of the chit fund institution over time. The model predicts a re-sorting of borrowers and lenders into groups of different durations as a consequence of the 30% ceiling. One implication of this re-sorting is that the proportion of short duration *groups* will also shift in response to the policy experiment. Indeed, we will see a dramatic increase in the proportion of these groups immediately following the imposition of the 30% ceiling. And even though there does appear to be some shaking out and some overshooting initially, this non-market institution settles into its new equilibrium, with a significantly higher fraction of short duration groups, in about two years. This result provides striking endorsement for the view that non-market institutions can be very responsive to changes in the economic environment that they operate in.

The paper concludes in Section 6 with some additional comments on the long-term institutional response to the policy experiment and a brief discussion on the regulation of non-market institutions.

2 The Institutional Setting

This section begins with a brief discussion on the prevalence and the importance of Roscas throughout the world. We pay particular attention to variation in the structure of this institution over space and time, since this tells us something about its flexibility. Subsequently we describe the organization of the commercial chit fund, which is the focus of this paper, in some detail. Finally, we document the events leading up to the imposition of the 30% ceiling, which is the exogenous policy experiment that lies at the heart of the empirical analysis.

2.1 The Prevalence and the Importance of Roscas

The generally accepted definition of a Rosca is provided by Ardener (1964:201): *An association formed upon a core of participants who agree to make regular contributions to a fund which is given, in whole or in part, to each contributor in rotation.* Institutions matching this description are found in urban and rural areas throughout the developing world (Geertz 1962 and Ardener 1964 provide comprehensive surveys), and even among migrant groups in advanced economies (Bonnet 1981, for instance, describes Roscas organized by West Indian immigrants in the U.S.). Numerous studies from throughout sub-Saharan Africa report that 50-80% of adult men and women participate in savings and credit groups, which include Roscas (Bouman 1995). In Taiwan, at least 20% of households participate in Roscas (*hui*) in a typical year (Levenson and Besley 1996). And in Tamil Nadu, the setting for this study, one million subscribers (8% of the adult urban population) were entered in *registered* chit funds in 1993 (Vaidyanathan and Sriram 2000).

Apart from their popularity, Roscas also play an important role in local economies throughout the world. Credit granted through Roscas (*tontine*) in Cameroon was about 27% of all loan requirements in the country (Schrieder and Cuevas 1992) and in Ethiopia, the 1968-73 Development Plan estimated the annual savings volume through Roscas (*ekubs*) to be 8-10% of GDP (Begashaw 1978). In Asia, *huis* provided 20-25% of the credit available in South Vietnam during 1965-75 (Bouman 1995), and we noted in the previous section that credit provided by registered chit funds was 12.5-25% of bank credit in the South Indian states of Tamil Nadu and Kerala.

While the Rosca may enjoy a substantial presence throughout the world, the popularity and the structure of the institution does vary across broad geographical areas. In Africa, for example, Roscas are concentrated in the more commercially developed regions of West Africa, and are particularly widespread in Cameroon and Nigeria (Geertz 1962). Similar regional variation is observed in India as well, and both informal and registered chit funds are concentrated in the three South Indian states of Kerala, Tamil Nadu and Andhra Pradesh. The structure of the institution also varies geographically. No interest is calculated, and bidding is absent, throughout Africa (Geertz 1962). In contrast, East Asian Roscas often use complex procedures to distribute the dividend, and both random and bidding Roscas are widely prevalent throughout Asia (Ardener 1964).

The structure of the Rosca also depends on whether it is organized in the village or the city. Rural Roscas tend to be informal, consisting of members with social ties to each other. 10-15 individuals typically form a group (Begashaw 1987, Campbell and Ahn 1962, Fernando 1986), and the pot is distributed by drawing lots in each period. In contrast, urban Roscas are usually anonymous institutions in which individuals without previous social ties to each other are brought together by a professional organizer. The pot is typically auctioned in each period, and this variant of the Rosca functions more as a financial intermediary, bringing borrowers and lenders together, than as a pure savings institution in which homogeneous individuals match together.

There are two basic explanations for the observed diversity of the Rosca institution. The first, essentially anthropological, explanation (due to Geertz 1962) is that the structure of the institution reflects the underlying culture of the participants. Thus urban Roscas differ from rural Roscas because individuals in the city are more "commercially" oriented, whereas norms of cooperative behavior continue to dominate in the village. Changes in the institution over time then reflect changes in underlying individual values and preferences. In contrast, the second, classical economic explanation for the observed diversity in the Roscas is that the structure of the institution responds to exogenous changes in the economic environment, while individual preferences remain stable. In this paper, we provide direct support for the second view by analyzing the institutional response to an exogenous economic shock, under the plausible assumption that endowments and preferences in the population remain stable over the short two-year period that we consider.

2.2 The Organization of the Commercial Chit Fund

While traditional chit funds have been widely prevalent in South Indian villages for centuries, the commercial chit fund is a relatively recent phenomenon. Ardener (1964) places the emergence of commercially organized 'Chit Fund Groups' at the beginning of the twentieth century, mostly in Chennai, and to some extent in Travancore and Cochin. But these commercial chit funds appear to have been quite rare, even as late as the 1970s. Anderson (1962) tells us that the first registered chit fund company in Hyderabad, the capital of Andhra Pradesh and another important center for chit fund activity today – the S.N. Chit Fund Co. – was founded in 1951. Similarly, the company that provided us with the data (Shriram Chits and Investments Pvt. Ltd.), one of the oldest and most established companies in Chennai, was founded in 1974. From our discussions with the founders of the company, there were only a handful of commercial chit fund companies in Chennai prior to that date.

The Indian financial system was nationalized in the early 1970s, after which only specially designated Non-Bank Financial Companies (NBFCs) were permitted to function as financial intermediaries, in competition with the government banks. One such NBFC was the commercial chit fund.[5] Companies that operate as registered chit funds have to satisfy a number of specific criteria. These criteria were first laid out in Section 2(2) of the Madras Chit Funds Act, 1961, which regulated the institution in the state of Tamil Nadu. Subsequently they were adopted in their entirety in the Miscellaneous Non-Banking Companies Directions, 1973, issued by the Reserve Bank of India, and ultimately in Section 2(b) of the central Chit Fund Act, 1982, which applies to the entire country:

"Chit" means a transaction whether called chit fund, chit, kuri, or by any other name, by which its foreman [the company] enters into an agreement with a number of subscribers that every one of them shall subscribe a certain sum or a certain quantity of grain by installments for a definite period and that each subscriber in his turn as determined by lot or by auction or by tender or in such other manner as may be provided for in the agreement shall be entitled to a prize amount.

Notice that this legal definition of a chit fund matches closely with Ardener's (1964) general definition of a Rosca that we provided earlier. As long as the chit fund is organized precisely along the lines laid out above, the company can operate as a financial intermediary, regulated by the Registrar of Chit Funds in each state, rather than by the Reserve Bank of India.

Chit fund companies organize their subscribers into groups. Members of a group meet once a month to auction the pot. A group is characterized by the amount of money that each subscriber contributes per month, and its duration (in months). Since the group meets each month, its duration reflects the number of members in the group. In our data, obtained from one chit fund company

[5] According to the Reserve Bank's definition, NBFCs include equipment leasing companies, hire purchase financing companies, loan companies, investment companies, mutual benefit financial companies (*nidhis*), miscellaneous non-banking companies (chit funds), residuary non-banking companies, and housing finance companies.

over the 1993-94 period, the contribution per month ranges from Rs.250 to Rs.25,000 (the exchange rate was roughly Rs.25 to the dollar at that time). The duration ranges from 20 months to 100 months. The subscriber thus has a menu of groups to choose from. Our chit fund company runs 20 neighborhood branches, spread throughout the city of Chennai. Individual subscribers will typically have no social ties with other members of their group. Individuals join independently, and a group is complete when the number of subscribers who have signed on, is equal to the posted duration. The company applies to the Registrar of Chit Funds at that point to commence the chit. While groups commence throughout the year, the company coordinates participation by organizing enrollment campaigns around *Pongal*, the Tamil New Year in April, and the *Divali (Ayudha Puja)* festival in October. 78,000 subscribers joined 2,000 groups in our chit fund company, in Chennai city alone, in 1993-94.

Since participants have no social ties to each other, the social sanctions that prevent default in the traditional Rosca have no bite in the commercial chit funds. The company must assume responsibility for defaults in this case. Most subscribers provide three guarantors, who are respected members of the community, and according to the branch manager's discretion, a subscriber may also be required to pledge property or other assets when he wins the pot. In the event that a subscriber nevertheless reneges on his institutional responsibility, the company will typically take him to court to realize the arrears. Default rates are very low – less than 5% in our data. The company facilitates the formation of the group, organizes the English auction on its premises each month, and is responsible for defaults. As compensation for its services, the company receives the first pot without competitive bidding, and subsequently receives 5% of the chit value (the value of the pot) in each month.[6]

As noted in the previous section, we discovered a number of corporate subscribers, listed as "finance companies," in the data. These companies list no guarantors and provide no security when they win the auction. Their promoters are most likely socially connected to the organizers of the chit fund, and this is presumably one way in which high default rates can be avoided while maintaining a sufficiently high implicit interest rate to encourage depositors. For the purpose of the statistical analysis that follows, the presence of the finance companies allows us to conveniently partition each group into borrowers and lenders. Consistent with this view we will see later that the corporate subscribers bid higher and win the pot on average much earlier than the private subscribers. The corporate subscribers account for approximately 20% of all the participants, and one important feature of the empirical analysis will be to see how the proportion of these subscribers responded to the imposition of the 30% ceiling in 1993.

[6]This compensation scheme is precisely laid down in Section 13 of the Madras Chit Funds Act, 1961, and was subsequently adopted without modification in Section 21 of the central Chit Funds Act, 1982.

2.3 The Policy Experiment

Government regulators, and particularly the Reserve Bank of India, were quick to take note of the growth of the chit funds and other NBFCs, following the nationalization of the banking system. Several committees were appointed to study the working of these companies, prominent among them being the Bhabatosh Datta Commission (1971) and the James Raj Commission (1975). These committees felt that while many NBFCs frequently resorted to unfair methods, and therefore needed to be regulated, prohibiting them entirely would adversely affect certain sectors of the economy that had limited access to bank credit, or chose not to deposit their money with the banks. For the particular case of the commercial chit fund companies, these study groups recommended a Model Bill, to be enacted as a Central Act of Parliament, to ensure uniform regulation throughout the country. They also recommended that the administration of the legislation should be left to the state governments.

The Government of India acted on these recommendations and passed the Chit Fund Act in 1982. The central chit fund act was modelled to a large extent on the Miscellaneous Non-Banking Companies Directions, an interim regulatory document issued by the Reserve Bank in 1973, which in turn was modelled closely on the Madras Chit Funds Act of 1961, which regulated the institution in the state of Tamil Nadu. Implementation of the Act was left to the Registrar of Chit Funds in each state. The 1982 Act departed most notably from the 1961 Act by imposing a 30% ceiling on the bids. The stated reason for the ceiling was to protect the depositors from defaults that would occur when the bids were pushed too high – this would be the standard story with adverse selection or moral hazard, in which only risky investors participate or only risky projects are chosen when interest rates are high. But it is very likely that the interest rates were also capped to restrict competition from the chit fund companies, since it was well understood that the higher interest rates that these companies could provide was perhaps their principal comparative advantage over the banks.[7]

Not surprisingly the chit fund companies went to court over the imposition of the ceiling. They were initially successful, and the Madras High Court granted a stay order in 1984 on a number of provisions of the 1982 Chit Funds Act, including the 30% ceiling.[8] However, the case did ultimately work its way through the courts, and after numerous appeals the stay order was vacated by the Supreme Court in September 1993. Given the enormous legal backlog, it is always difficult to predict when a case will come up for hearing in the Indian judicial system, and the numerous appeals that were filed in this case would only have added to the uncertainty surrounding the timing of its completion. We will thus find it reasonable to treat the 30% ceiling imposed in September 1993, a full eleven

[7] As the Shah Commission report (1992:20), prepared for the Reserve Bank, put it: *The importance of interest differential as a motivating factor for transfers of deposits from commercial banks to NBFCs is well recognized ... The NBFCs compete with the monetary system and [therefore] there is need to regulate them.*

[8] The chit fund company is required to deposit a fixed proportion of the value of the pot with the Registrar of Chit Funds prior to commencement of the group as security. The required deposit level was increased in the 1982 Act over its 1961 level, which was another issue that the chit fund companies took to court.

years after the passing of the 1982 Chit Funds Act, as an unpredicted policy shock. The empirical analysis will compare the formation of chit fund groups, one year before and one year after September 1993. Over a longer period of time, we will also study the speed at which the institution was able to respond to the policy shock, and settle into its new equilibrium.

3 A Simple Model of Chit Fund Auctions

We now proceed to formalize the formation of groups and the pattern of bids in the chit fund auctions. In this simple model, there are two types of participants: high types and low types. High types have superior investment opportunities, and because in equilibrium they collect the pot earlier on average than the low types, we will often refer to them as the borrowers. The low types are the lenders. We solve the model in two stages. The first stage is the matching stage. Each agent chooses to participate in a chit fund of a certain duration, based on the expected future payoff from that chit fund. The second stage determines the payoff from the auction.

Given a menu of chit funds, the participant chooses that fund that maximizes her expected future payoff. We will see that the proportion of high types acts as a *price* in this institution, adjusting to leave each agent indifferent between the various types of chit funds in equilibrium. For example, if an exogenous shock increases the payoffs that the high types receive in one type of chit fund, relative to the other funds that are available, then this will generate an inflow of high types into that chit fund (which lowers the payoffs that they receive) until indifference is restored once again.

Section 3.1 describes the population and preferences, the matching technology and the auction technology. We solve the model backwards, starting in Section 3.2 with the pattern of bids in the second stage auction, and the payoffs that the participants receive. Subsequently, Section 3.3 derives the first stage sorting equilibrium. The analysis concludes in Section 3.4 by studying how the proportion of high types, in groups of different durations, responds to the exogenous 30% ceiling on bids that was put in place in September 1993. This will later allow us to empirically identify the presence of underlying endogenous matching.

3.1 Population, Preferences, and the Auction Technology

3.1.1 Population and Preferences

Let there be a continuum of infinitely lived chit fund participants. Each participant is indexed by an observable type $\gamma, \gamma \in \left\{\overline{\gamma}, \underline{\gamma}\right\}$, where $\overline{\gamma} > \underline{\gamma}$ and where the proportion of high types in the population is μ and the proportion of low types is $1-\mu$. Participants of type γ who manage to find finance have access to a deterministic investment opportunity with a return $1+\gamma$. The heterogeneity amongst agents derives from the return on the investment opportunity. Though both types can derive positive returns from investment, we will often refer to the high types $\overline{\gamma}$ as *borrowers* and the low types

$\underline{\gamma}$ as *lenders*. This follows from the fact that the high types will have a higher willingness to pay for funding, and are therefore willing to move early in the chit fund auction. All participants are risk neutral utility maximizers who discount the future at a common and constant discount factor $\delta \in [0, 1)$. Time is discrete.

3.1.2 The Matching Technology

The organizer of the chit fund offers a menu of groups for potential participants to choose from. Each chit fund auction is characterized by the number of participants in the group N, the contribution that each participant must make each period v, and the proportion of high types in the group $p \in [0, 1]$. Thus, each chit fund group is characterized by a triple $\langle N, p, v \rangle$. Of course, p is endogenously determined by each individual's participation decision. So the chit fund organizer's menu only announces N, v. Denote $W(\gamma, N, p, v)$ the normalized expected payoff to an agent of type γ from participation in a chit auction $\langle N, p, v \rangle$, where W is determined as the equilibrium in the second stage subgame.

Matching is instantaneous and without frictions. All agents simultaneously decide which fund to participate in and therefore choose N, v from the menu such as to maximize $W(\gamma, N, p, v)$ subject to the market clearing condition (that the aggregate number of high types in each chit fund equals the initial proportion in the total population). For any interior solution, the proportion p acts as a balancing force to make agents indifferent between different types of chit funds on the menu. As a result, an equilibrium matching will specify a p for each auction N, v.

3.1.3 The Auction Technology

Given a chit fund $\langle N, p, v \rangle$, p is taken as given in the second stage. Now the auction technology determines the expected payoff for each type $W(\gamma, N, p, v)$. In each period $t = 1, ..., N$, all participants in a group contribute a rupee amount v to the fund, and at the same time, at each t a first price sealed bid auction is conducted in which the highest bid wins. Each chit fund member can win the auction only once, so that participants in the auction are all those $N - t + 1$ chit fund members who have not won the auction yet. The winner receives the period's contribution of all N participants Nv and pays the highest bid. The bid paid by the winner is distributed equally amongst the remaining $N - t$ participants, i.e. those who have not won the auction yet.

The set up of the model is consistent with the actual organization of the chit fund auction in that there are no restrictions on the information concerning past bids, or the identity of past winners. However, the model departs in two ways from the actual chit fund auction. First, we model the bidding as a first price sealed bid auction instead of the English auction used in practice. It is well known that with private independent values and risk neutral bidders, revenue equivalence is guaranteed for both static auctions.[9] Second, all N participants in the group, including the most

[9]In fact, the English auction and the second price auction are strategically equivalent for static independent private

recent winner, share the winning bid equally each period in practice. While the assumption in the model does not change the nature of the auction, the advantage of the setup we have chosen is that it simplifies the expression for the continuation payoff that we derive for each type and makes the model analytically tractable.

It is assumed that each player, in addition to her type γ receives an i.i.d. signal σ_t in each period, with σ_t uniformly distributed over $[-\varepsilon, \varepsilon]$. As a result, the valuation of the investment for type γ in period t is $Nv(1+\gamma)+\sigma_t$. The introduction of the i.i.d. signal is for technical convenience. It rules out tie-breaking bids when there is only one high type. Therefore, we will consider equilibria where ε – and as a result σ_t – is very small and approaches 0. Denote the pair $b_t = \left(\overline{b}_t, \underline{b}_t\right)$ the bids by each of the types. Then the vector $b = (b_1, b_2, ..., b_N)$ indicates the strategy profile of all participants in a given chit fund. In a given chit fund auction $\langle N, p, v\rangle$, let $V_t(\gamma, b; N, p, v)$ denote the expected continuation payoff (conditional on not having won the auction in the past) at time t for player γ, and given a strategy profile b. We will use the short hand notation to indicate $\overline{V}_t = V_t(\overline{\gamma}, b; N, p, v)$ and $\underline{V}_t = V_t\left(\underline{\gamma}, b; N, p, v\right)$.

3.2 The Second Stage: Strategic Bidding

We solve the model backwards starting in the second stage. For the determination of the equilibrium matching in the first stage, it turns out that we only need to derive the *difference* $\Delta V_t = \overline{V}_t - \underline{V}_t$ (and in particular ΔV_1). We therefore have the following result:

Proposition 1 *For all* $t < N$

$$\Delta V_1(N, p) = \delta^{pN-1} \Delta V_N \tag{1}$$

and $\triangle V_N = Nv\left[\overline{\gamma} - \underline{\gamma}\right] = Nv \triangle \gamma$.

The proof is reported in the Appendix. In order to get the intuition for this result, we derive the equilibrium continuation value of a given auction N, v and a given proportion of high types p (i.e. with pN high types in the group) for the case where ε approaches 0. We can write the high type's expected payoff in period $t \leq pN$ as

$$\overline{V}_t = \frac{1}{pN - t + 1}\left(\overline{V}_N - \overline{b}_t\right) + \left(1 - \frac{1}{pN - t + 1}\right)\left(\delta \overline{V}_{t+1} + \frac{1}{N-t}\overline{b}_t\right)$$

where $\overline{V}_N = Nv(1+\overline{\gamma})$ is the payoff in the last period, which is also equal to the return from investing. Because in equilibrium, bids by the high types always dominate those by the low types, the probability of winning for a high type is $1/(pN - t + 1)$, where $pN - t + 1$ is the number of high types remaining in period t. When the individual wins, the payoff is the return on investment $\overline{V}_N$ less the bid $\overline{b}_t$. With complementary probability, the high type loses and gets the discounted expected

value auctions. Further, revenue equivalence is guaranteed between the second and first price auctions, and because of strategic equivalence, also between the English and first price auctions.

payoff in the next period plus her share of the bid $\overline{b}_t$ that is distributed equally amongst the $N-t$ remaining players who have not won yet.

In the appendix, we show that for $t=1,...,pN-1$, the equilibrium strategy of the high types is to bid $\overline{b}_t = \frac{N-t}{N-t+1}\left(\overline{V}_N - \delta\overline{V}_{t+1}\right)$. The intuition behind this is that in all those periods, high types are competing with high types. As a result, the bidding makes a player indifferent between winning the auction today, and losing and getting the discounted continuation payoff and the share of the bid: $\overline{V}_N - \overline{b}_t = \delta\overline{V}_{t+1} + \frac{1}{N-t}\overline{b}_t$. This implies that for $t=1,...,pN-1$, the equilibrium expected payoff is given by

$$\overline{V}_t = \overline{V}_N - \overline{b}_t = \delta\overline{V}_{t+1} + \frac{1}{N-t}\overline{b}_t.$$

For the low types, who lose for sure in the early periods, the corresponding payoff is expressed as

$$\underline{V}_t = \delta\underline{V}_{t+1} + \frac{1}{N-t}\overline{b}_t.$$

We can now calculate ΔV_t immediately from the equilibrium payoffs above: $\Delta V_t = \delta\Delta V_{t+1}$. Solving recursively, $\Delta V_1 = \delta^{pN-1}\Delta V_{pN}$.

In period $t=pN$, there is only one high type left, and she now competes with all the low types. She can win the auction for sure by offering ε above the bid of the low type (recall that ε is the bound of the symmetric support of σ_t). Therefore, for small ε, in period $t=pN$, $\overline{b}_t = \underline{b}_t = \frac{N-t}{N-t+1}\left(\underline{V}_N - \delta\underline{V}_{t+1}\right)$ are equilibrium bids. The low types bid up to the point where they are indifferent between winning the auction and losing. This implies

$$\begin{aligned}\overline{V}_t &= \overline{V}_N - \overline{b}_t \\ \underline{V}_t &= \delta\underline{V}_{t+1} + \frac{1}{N-t}\overline{b}_t = \underline{V}_N - \underline{b}_t.\end{aligned}$$

Differencing the equations above, at $t=pN$, $\Delta V_{pN} = \Delta V_N$. We can therefore conclude that $\Delta V_1 = \delta^{pN-1}\Delta V_N$, giving us the result in Proposition 1.

Before turning to the determination of the matching equilibrium in the first stage, we normalize the expected payoff from participation in the auction to account for the fact that different funds have different durations. For each type γ, the normalized payoff from participation in the chit fund is equal to

$$W(\gamma,N,p) = \frac{V_1(\gamma,N,p)}{1-\delta^N}.$$

Hence we can define

$$\triangle W(N,p) = \overline{W}(N,p) - \underline{W}(N,p) = \frac{\triangle V_1(N,p)}{1-\delta^N} = \frac{\delta^{pN-1}Nv\triangle\gamma}{1-\delta^N}. \tag{2}$$

Next, two comparative statics properties of the expected equilibrium payoff are derived. The first basic property of $\triangle W$ is that it is decreasing in p.[10]

[10]Of course, p is not a continuous variable for a finite N and given that p is the fraction of high types. However, for the remainder of the discussion we will treat p (and N) as continuous variables. This is without loss of generality as it is easily verified that the properties of the derivatives can be replicated using differences.

Lemma 1. *Consider a chit fund and any $N, \delta, v, \overline{\gamma}, \underline{\gamma}$. Then*

$$\frac{d \triangle W(N,p)}{dp} < 0$$

Proof. First, observe that $\frac{d\triangle W(N,p)}{dp} = \frac{1}{1-\delta^N}\frac{d\triangle V_1(N,p)}{dp}$. Then it immediately follows from equation (1) that

$$\begin{aligned}\frac{d\Delta W}{dp} &= \frac{\delta^{pN-1}\Delta V_N}{1-\delta^N} N \ln \delta \\ &= \Delta W N \ln \delta < 0\end{aligned}$$

since $\ln \delta < 0$. ■

The intuition for this result is fairly straightforward. As p increases, competition between the high types increases, pushing up the high types' bids in the early periods. Higher bids imply a higher revenue for the low types as the gains are distributed amongst the losers. This makes the auction *relatively* less attractive to the high types and more attractive to the low types, i.e. $\triangle W(N,p)$ decreases.

The second basic property of $\triangle W$ is that $\triangle W$ is decreasing in N for sufficiently low values of δ.

Lemma 2. *Consider a chit fund and any $N, \delta, v, \overline{\gamma}, \underline{\gamma}$. Then there exists a δ^* such that for $\delta < \delta^*$*

$$\frac{d \triangle W(N,p)}{dN} < 0$$

Proof. Again, from equations (2) and (1) it follows that

$$\frac{d\Delta W}{dN} = v\Delta\gamma \frac{\delta^{pN-1}}{\left(1-\delta^N\right)^2}\left[(\ln\delta \cdot pN + 1)\left(1-\delta^N\right) + N\delta^N \ln\delta\right]$$

Observe that as δ approaches 1, $\frac{d\Delta W}{dN} = 0$ and as δ approaches 0, $\frac{d\Delta W}{dN}$ goes to $-\infty$. Thus, even if $\frac{d\Delta W}{dN}$ is positive for some values of δ, it must be negative for δ sufficiently small (close to zero). A sufficient condition for $\frac{d\Delta W}{dN} < 0$ is that $\ln\delta \cdot pN + 1 < 0$, since $ln\delta < 0$, which implies $\delta < e^{-\frac{1}{pN}} \in [0,1]$. As a result, there exists a $\delta^* \geq e^{-\frac{1}{pN}}$ such that for all $\delta < \delta^*$, $\frac{d\Delta W}{dN} < 0$. ■

3.3 The First Stage: Endogenous Matching

We now proceed to describe the process by which participants sort themselves into chit fund groups. Each group is characterized by the number of participants N, the chit fund value v, and the (common) belief about the proportion of high types p that will decide to join the fund N, v. In equilibrium, this belief must be consistent with utility maximizing behavior. A potential participant choosing between alternative chit fund groups will compare the normalized continuation value W of each group.

Suppose that a menu of chit funds $\langle N,p\rangle_i$ is offered to potential participants. Then for each chit fund N_i, there will be associated an equilibrium belief $p(N_i)$ denoted by p_i. An *endogenous matching*

equilibrium requires every participant to choose that chit fund that maximizes the normalized value function $W(\gamma, N_i, p_i)$. If different types of chit funds are to coexist, then the utility maximization requires $N \in \arg\max_N W(\gamma, N, p(N))$. In the case of a symmetric equilibrium with two types, a solution to this problem is interior[11], and implies

$$W(\gamma, N_i, p_i) = W(\gamma, N_j, p_j), \forall \gamma, \forall i \neq j. \tag{3}$$

It follows immediately that if condition (3) is satisfied for both $\underline{\gamma}$ and $\overline{\gamma}$, then the difference in the normalized value $\triangle W(N, p)$ will also be equalized across the chit funds:

$$\triangle W(N_i, p_i) = \triangle W(N_j, p_j), \forall i \neq j. \tag{4}$$

In addition, a condition must be satisfied that requires the beliefs p_i in each chit fund be consistent with the proportion μ of high types in the entire population. Consider the case of two types $\overline{\gamma}, \underline{\gamma}$ with fractions $\mu, 1-\mu$ out of a total of n participants. Let the measure of groups of type i in equilibrium be n_i. Then the consistency condition requires

$$\sum_i n_i p(N_i) N_i = \mu \sum_i n_i N_i \tag{5}$$

where the total measure of participants is $\sum_i n_i N_i = n$.

We can now state the characterization of the endogenous matching equilibrium in the next Proposition. It says that under efficient sorting, the equilibrium proportion of high types $p(N)$ in each fund is systematically related to N. For the remainder of the discussion, we use the notation $p_i = p(N_i)$.

Proposition 2 *(Endogenous Matching) Consider any two chit funds i, j with $N_i < N_j$. Then there exists a δ^* such that for $\delta < \delta^*$ endogenous matching equilibrium satisfies $p_i > p_j$.*

Proof. From Lemma 2, it follows that for $\delta < \delta^*$

$$\triangle W(N_i, p) > \triangle W(N_j, p), \forall p$$

since $N_i < N_j$. Then, evaluated at $p = p_i$, this implies

$$\triangle W(N_i, p_i) > \triangle W(N_j, p_i)$$

In equilibrium, $\triangle W(N_i, p_i) = \triangle W(N_j, p_j)$ from equation (4), so that

$$\triangle W(N_j, p_j) > \triangle W(N_j, p_i)$$

[11] Consider first the case where $p = 0$. Then there are no gains from trade to the low types (i.e. they will receive the same utility as under autarky), while the high types do benefit from funds where $p = 0$. As a results, high types will join the fund. On the other hand, from Lemma 1, the high types are relatively worse off as more high types enter (and the low types are better off). A similar argument applies to the case where $p = 1$, and as a result, an interior solution always exists.

This implies, from Lemma 1, that $p_i > p_j$, which establishes the proof. ■

The intuition for this result is very simple. We know from Lemma 2 that $\triangle W$ is greater in short duration groups, for a given p. Thus p must be larger in the short duration groups, from Lemma 1, to equalize $\triangle W$ across groups of different duration.

3.4 The Policy Experiment and the Change in Endogenous Matching

The law that came into force in September 1993 caps the bids at 30% of the auction value Nv. We will now proceed to study the effect of this restriction on the sorting equilibrium. Two different effects of capping on the sorting equilibrium are distinguished: the entry effect and the substitution effect. Of course, empirically only the total (entry plus substitution) effect can be observed, but the theory allows us to derive separate predictions for each of those effects.

We begin by showing that for a given p and N, the effect of capping the bids in 1993 is to increase $\overline{W}$ and decrease $\underline{W}$. The first implication of this change is that more high types decide to participate in all auctions, with a corresponding decline in participation among the low types. As a result, the ratio μ of high types increases after capping the bids. We call this the *entry effect*: the effect on the sorting equilibrium of an increase in the proportion of high types μ, while keeping all chit funds unconstrained. While the entry effect increases the proportion of borrowers in all chit funds, we will show that this effect is (mechanically) larger in the short duration funds. Apart from the entry effect, capping the bids in select groups also leads both types to substitute between different chit funds: payoffs change, and as a result, the low types now move into the unconstrained funds while the high types tend to move into the capped funds. We call this the *substitution effect*: the effect on the sorting equilibrium of changing W (increasing $\overline{W}$ and decreasing $\underline{W}$) while μ is kept fixed.

Denote $\overline{W}(b^c) = \overline{W}^c$ and $\underline{W}(b^c) = \underline{W}^c$ as the continuation payoffs for high and low types in the capped groups, where b^c denotes the vector of constrained equilibrium bids in these groups, $b_t^c \leq \overline{b}_t, \forall t$. Then $\triangle W^c = \overline{W}(b^c) - \underline{W}(b^c)$. We show in the following Lemma that the difference in continuation values in a constrained chit fund $\triangle W^c$ is larger than in an unconstrained chit fund $\triangle W$.

Lemma 3. *Fix p and N and let the high bids be constrained ($\underline{b}_1 \leq b^c \leq \overline{b}_1$), then: 1. $\overline{W}^c \geq \overline{W}$; 2. $\underline{W}^c \leq \underline{W}$; 3. $\triangle W^c \geq \triangle W$.*

Proof. In the unconstrained equilibrium, the payoff to the high types is

$$\overline{W} = \frac{\overline{V}_1}{1-\delta^N} = \frac{\overline{V}_N - \overline{b}_1}{1-\delta^N}$$

and for the low types

$$\underline{W} = \frac{\underline{V}_1}{1-\delta^N} = \frac{1}{1-\delta^N}\left[\delta \underline{V}_2 + \frac{1}{N-1}\overline{b}_1\right]$$

Now given the high bid in the first period is constrained ($\underline{b}_1 \leq b^c \leq \overline{b}_1$), $\overline{W}^c > \frac{\overline{V}_N - \overline{b}_1}{1-\delta^N} = \overline{W}$. Likewise, $\underline{W}^c < \frac{1}{1-\delta^N}\left[\delta \underline{V}_2 + \frac{1}{N-1}\overline{b}_1\right] = \underline{W}$, because the low types are not constrained and $\underline{V}_2$ is not affected by the period's constraint. It now immediately follows that $\triangle W^c \geq \triangle W$. ■

By capping the bids, we are exogenously reducing the competition among the high types, which must make them better off relative to the low types ($\triangle W$ increases), for a given p and N.

3.4.1 The Entry Effect on Sorting

We now focus on the entry behavior of all types, even before a particular auction is chosen. Lemma 3 shows that when bids are capped, any auction becomes less attractive to the low types and more attractive to the high types (for a given p and N). This will affect the entry decision of all participants. In particular, we expect an increase in the fraction of high types μ.[12]

What will be the effect of an increase in μ on the sorting equilibrium, assuming that all funds continue to be unconstrained? Consider the sorting equilibrium with two types of chit funds offered N_1, N_2, where $N_1 < N_2$. Let $p_1 = p(N_1)$ and $p_2 = p(N_2)$ and let the superscripts E, S denote the equilibrium values associated with the entry and substitution effect respectively. Then the following Proposition follows.

Proposition 3 *(Entry Effect) If μ increases (i.e. $\mu^E > \mu$) while keeping all chit funds unconstrained, then the fraction of high types increases more in the short duration chit fund N_1 than in the long duration chit fund N_2: $p_1^E - p_1 > p_2^E - p_2$.*

Proof. If p_1, p_2 are equilibrium values, then the equilibrium conditions $\overline{W}(p_1) = \overline{W}(p_2)$ and $\underline{W}(p_1) = \underline{W}(p_2)$ imply

$$\begin{aligned} \Delta W(p_1) &= \Delta W(p_2) \\ \delta^{p_1 N_1 - 1} \frac{N_1 v \Delta\gamma}{1 - \delta^{N_1}} &= \delta^{p_2 N_2 - 1} \frac{N_2 v \Delta\gamma}{1 - \delta^{N_2}} \end{aligned}$$

which, after taking logs of both sides and rearranging, implies

$$p_1 N_1 - p_2 N_2 + C = 0 \tag{6}$$

where

$$C = \ln\left(\frac{N_1}{N_2}\frac{1 - \delta^{N_2}}{1 - \delta^{N_1}}\right)\frac{1}{\ln\delta} > 0$$

We now show that as a result of an increase in μ, sorting equilibrium will imply that p_1 increases more than p_2. Consider any increase in μ to $\mu^E > \mu$. This generates a corresponding increase in p_1,

[12] Think of all types having a private cost c of entering an auction, with c distributed according to the cdf $\overline{F}(\mathrm{c})$ and $\underline{F}(\mathrm{c})$. Then participation in chit funds is beneficial as long as $W - \mathrm{c} \geq 0$. Obviously, there will be a fraction $\overline{F}(\overline{\mathrm{c}}^*)$ high types participating where $\overline{\mathrm{c}}^*$ satisfies $\overline{W} - \overline{\mathrm{c}}^* = 0$. Similarly for the low types, so that

$$\mu = \frac{\overline{F}(\overline{\mathrm{c}}^*)}{\overline{F}(\overline{\mathrm{c}}^*) + \underline{F}(\underline{\mathrm{c}}^*)}.$$

If $\overline{W}$ increases, $\overline{\mathrm{c}}^*$ will increase and as a result so will $\overline{F}(\overline{\mathrm{c}}^*)$. The opposite is true, i.e. that $\underline{F}(\underline{\mathrm{c}}^*)$ decreases, if $\underline{W}$ decreases. It immediately follows that μ will increase.

p_2 to p_1^E, p_2^E, while the equilibrium for p_1^E and p_2^E continues to require

$$p_1^E N_1 - p_2^E N_2 + C = 0.$$

This implies in turn, from equation (6), that

$$(p_1^E - p_1)N_1 - (p_2^E - p_2)N_2 = 0.$$

Since $N_1 < N_2$, it follows immediately that $p_1^E - p_1 > p_2^E - p_2$. ■

3.4.2 The Substitution Effect on Sorting

Next consider the substitution effect on the sorting equilibrium, as a consequence of the change in the expected payoff in each of the funds. Keeping the fraction of high types μ constant, we now consider how a change in the payoffs in capped chit funds affects the sorting of types into different funds. As before, we assume that there are two types of funds, N_i and N_j, where fund N_j is capped while N_i is unconstrained.

Proposition 4 *(Substitution Effect) If $\overline{W}$ increases and $\underline{W}$ decreases (i.e. $\overline{W}^S > \overline{W}, \underline{W}^S < \underline{W}$) for N_j while keeping $\overline{W}, \underline{W}$ for N_i and μ unchanged, then the fraction of high types increases less in the unconstrained chit fund than in the constrained chit fund: $p_i^S - p_i < p_j^S - p_j$.*

Proof. Since N_i is unconstrained,

$$\triangle W^S(p_i) = \triangle W(p_i).$$

On the other hand, N_j is constrained, and $\overline{W}^S > \overline{W}, \underline{W}^S < \underline{W}$ which implies

$$\triangle W^S(p_j) > \triangle W(p_j).$$

Equilibrium prior to the capping requires that

$$\triangle W(p_i) = \triangle W(p_j),$$

which implies from the equations above that

$$\triangle W^S(p_i) < \triangle W^S(p_j).$$

Now equilibrium after the capping requires,

$$\triangle W^S(p_i^S) = \triangle W^S(p_j^S),$$

so p_i,p_j must shift to restore equilibrium. Since μ is fixed and there are only two types of groups, the consistency condition, equation (5), tells us that p_i,p_j must shift in opposite directions. This follows

immediately from the observation that μ is a weighted average of p_i,p_j before the capping and p_i^S, p_j^S after the capping.

From Lemma 1, $\frac{d\triangle W}{dp} < 0$, p_i must decrease and p_j must increase to restore equilibrium after the capping:

$$p_i^S - p_i < p_j^S - p_j.$$

■

We know from Lemma 3 that the capping exogenously increases $\triangle W$ in the constrained groups, for a given p and N. This implies, from Lemma 1, that p must increase more in the constrained groups to restore equality in $\triangle W$ across different types of groups.

The entry effect is simply a mechanical change in the sorting equilibrium as a consequence of the change in μ. To establish that participants match endogenously, we need to show that the substitution effect is present. From Proposition 3 the entry effect increases the proportion of high types more in *short duration* groups; $p_1^E - p_1 > p_2^E - p_2$. From Proposition 4 the substitution effect increases the proportion of high types more in *capped* groups; $p_i^S - p_i < p_j^S - p_j$. We will later verify empirically that it is the long duration funds that are capped, so the entry and the substitution effects work in opposite directions. Thus, if we were to empirically establish that the proportion of high types increases more in the capped (long duration) groups, then this would tell us unambiguously that participants actively re-sort following the policy experiment.

4 Testing the Theory

We now proceed to test the implications of the model. We begin with a description of the various data sources used in the empirical analysis in Section 4.1. Chit fund groups are subsequently partitioned into aggregate chit value-duration categories in Section 4.2, while individual participants are classified as low and high types in Section 4.3, which allows us to implement the empirical tests. Section 4.4 studies the sorting equilibrium prior to the experiment (Proposition 2), Section 4.5 studies the pattern of bids before and after the experiment, and Section 4.6 studies the change in sorting from 1993 to 1994 (implied by Proposition 3 and Proposition 4). The main result of this section is that the proportion of high types p increases much more sharply in capped groups, which implies unambiguously (in this particular setting) that the sorting effect is present and hence that participants are matching endogenously.

4.1 The Data

We use three sources of data in this paper. First, we obtained a complete record of *all* winning bids in *all* the groups operated by Shriram Chits and Investments Pvt. Ltd. that commenced between October 1, 1992 and September 30, 1994 in the city of Chennai. The sample period covers exactly

one year before and one year after the imposition of the 30% cap on September 30, 1993. When we refer to the years 1993 and 1994 henceforth in the paper, we will actually be referring to the October 1 to September 30 period just before and just after the capping. Chennai is the largest commercial city in South India, and Shriram Chits, which is the largest chit fund company in the state of Tamil Nadu, has its headquarters, and 20 neighborhood branches, in the city. In total, 78,000 individuals participated in the chit fund groups that commenced in the city during the sample period.

Our second source of data provides income information for a limited number of subscribers in the sample. While the winning bids and the group characteristics are computerized and readily available, this additional subscriber information can only be obtained from the application forms which are filled in at the time of entry. These application forms are subsequently stacked in back rooms in each branch office, located all over the city. We picked a random sample of groups and then attempted to obtain income information on all their participants, from the respective branches. Ultimately, this information was collected for 21,906 subscribers (roughly 25% of the full sample). We appear to have been more successful in collecting this additional information for individuals belonging to groups that commenced in 1994, and thus there is some concern that this restricted sample may not be randomly selected. We should emphasize, however, that income data will only be used in a few exploratory regressions and to report some basic statistics; it is not required for the bulk of the analysis.

And finally, our third source of data is an aggregate break down of groups, based on the size of the pot auctioned in each month and the duration, in each year over the 1992-2001 period. Extensions to the analysis that we report later in Section 5 will use these aggregate data to study changes in the structure (duration) of the groups over time.

4.2 Classification of Groups

Each branch posts a menu of available groups at each point in time, where each group is characterized by the chit value (the total amount to be auctioned each month) and the duration (in months). Each participant chooses the group-type that is appropriate for her, based on its characteristics and the composition of types that she expects to match with in equilibrium. Once a group fills, it is allowed to commence after the necessary permission from the Registrar of Chit Funds has been obtained. The company offers a wide range of chit value-duration combinations, and the first step in the empirical analysis will be to classify the groups, along both the chit value and duration dimensions, into a smaller number of aggregate categories.

While new groups form throughout the year, the company helps coordinate the formation of these groups by organizing two major subscription campaigns each year - during the Tamil New Year in April and the *Ayudha Puja* (Divali festival) in October. The company also encourages participation by offering entering gifts when the individual joins a group. For the purpose of the discussion that follows, it is important to note that the value of these gifts is based on the chit value, rather than

the individual's monthly contribution. The company seems to make the implicit assumption that individuals save to achieve a target, instead of simply putting away a constant fraction of their income each month. The individual's participation decision is thus seen to be based on the total amount that she expects to deposit, rather than the payment that she makes each month. Following the company's lead, we will use the chit value, rather than the monthly contribution, to classify groups in the discussion that follows.

Chit values range from Rs.10,000 to over Rs.100,000 in our data. The level of the individual's savings target, which is measured by her choice of chit value, must naturally be based on her income. The probability that a subscriber will choose a low (high) chit value will most likely be declining (increasing) with income. The empirical relationship between the choice of chit value and income thus allows us to conveniently partition groups along the chit value dimension.

Table 1 presents multinomial logit and linear probability estimates of the chit value regression. The Rs.30,000 chit value is treated as the base category in the multinomial logit regression in Panel A, while separate regressions are estimated for each chit value to obtain the linear probability estimates in Panel B. Even though 16 chit values are observed in the data, we restrict attention to six values in Table 1, which together account for over 90% of all the observations in our sample.

Insert Table 1 here.

As expected, the individual is significantly *less* likely to choose the lowest Rs.10,000 chit value as her income increases. She is, however, significantly *more* likely to choose the highest Rs.50,000 and Rs.100,000 chit values as her income grows. These results are obtained with both the multinomial logit model and the linear probability model. For the intermediate Rs.15,000-Rs.30,000 values, the chit value-income relationship is not as clear cut. It would thus seem natural to classify the Rs.10,000 groups as *low* value, the Rs.15,000-Rs.30,000 groups as *medium* value, and the Rs.50,000 and Rs.100,000 groups as *high* value.

The patterns just described are easy to visualize with the nonparametric kernel regressions, which correspond to the linear probability estimates, in Figure 1. There is a clear visual distinction between the low, medium and high value chits. The trajectory is sharply negative for the Rs.10,000 chit value, while the direction of the trend is reversed for the Rs.50,000 and Rs.100,000 values. Once more, the pattern is ambiguous for the intermediate values.

Insert Figure 1 here.

We follow the company's lead once again, to partition groups along the duration dimension. Later we will see that the long duration (large N) groups were affected most the 30% ceiling. The organizing company made efforts to reduce this effect by changing the design of the auction, as of October 2000. These changes were restricted to groups with durations 40 months or longer, which are classified by

the company as "long duration groups." We will use the same duration classification in the empirical analysis.

Table 2 describes the different groups that commenced over the 1993-94 period, and shows the broad classification by chit value and duration that we have adopted. As before, we restrict attention to the six major chit values. There are seven different durations, ranging from 20 months to 100 months, associated with these six chit values. This leaves us with 42 distinct chit value-month combinations, which are aggregated into six combinations using the Low, Medium, High classification on the chit value dimension, and the Short, Long classification on the duration dimension. While there are a number of "gaps" in Table 2, notice that this classification leaves us with a sufficiently large number of groups in each aggregate category.

Insert Table 2 here.

4.3 Classification of Participants

When we classify groups into six broad categories we are relying on the idea that income constraints, and the target savings level, lock the individual into a particular chit value. The only choice that is available over time is whether to join a long or short duration group, which will allow us to estimate the sorting and the bidding regressions separately within each category. But this is not appropriate if the individual's participation decision is based instead on her monthly contribution. Given the likely change in duration over time, individuals with the same endowments and preferences would then end up in *different* chit values before and after the 30% ceiling.

We consequently proceed to verify that the characteristics of participants, within each chit value category, remained the same over the 1993-94 period. The only change in the economic environment in that case would be brought about by the 30% bid cap, which allows us to isolate the effect of the exogenous institution-specific shock on the matching equilibrium. Looking down the distribution in Table 3, Panel A, separately for low, medium, and high chit values, we see that incomes are remarkably similar in 1993 and 1994 at all quantile levels, except at the very top of the income distribution. This indicates that the underlying income distribution of participants was unchanged *and* that the choice of chit values was unaffected by the capping of the bids in 1994.[13]

Insert Table 3 here.

The stability of the income distribution in Table 3, Panel A, for all chit values, would seem to support the use of the chit value to partition groups. But as an additional test, we will also verify that all our regression results are robust to an alternative classification scheme, in which groups are partitioned into low, medium, high *monthly contributions*, with the cut-offs set at Rs.500 and Rs.1000

[13]We ignore the knife-edge case in which changes in the income distribution and changes in the choice of chit value just cancel each other.

per month. While not reported here, these cut-offs are constructed using the same approach described earlier in Table 1 and Figure 1.

The discussion up to this point has allowed us to partition the groups into a small number of aggregate categories. We have also verified that the income distribution was unchanged over the short two-year period that we consider, allowing us to isolate the effect of the 30% cap. However, we still need to classify participants as low types and high types.

Recall that high types receive a higher return on their outside investments and so will bid higher and win earlier in equilibrium. As noted in the Introduction, a particularly convenient feature of this institution is that we can identify *ex ante* borrowers; there is a separate field in the records that flags "finance companies." As seen in Table 3, Panel B, these corporate subscribers account for approximately 20% of all the observations in our data. The proprietors of these select companies appear to be trusted by the chit fund organizers, and most likely have social ties to them. While the individual subscribers must provide information on their income, assets, and occupation to the chit fund organizers, and also furnish the names and addresses of three guarantors, the corporate subscribers face none of these requirements. The money collected from the auction is invested elsewhere by these companies, who clearly have access to superior investment opportunities than the individual subscribers who are for the most part salaried employees.

To verify that this classification of types, based on *ex ante* characteristics, is indeed appropriate, we compare the timing of winning bids for corporate and individual subscribers in Table 4. The timing variable is defined as the month in which the individual wins the auction divided by the total duration of the group, and so ranges from zero to one. The corporate subscriber variable equals one for finance companies, zero otherwise. The linear probability model is used to estimate the Timing regression, so the constant term measures the average timing for the individual subscribers, while the corporate subscriber variable measures how much earlier the finance companies win on average. We would expect high types to win early, and as expected the corporate subscriber coefficient is large in absolute magnitude and very precisely estimated. The same result is obtained, without exception, in 1993 and 1994, for low, medium, and high value groups. We will consequently treat the corporate subscribers as high types and the individual subscribers as low types in the empirical analysis that follows. The proportion of high types p, which helps us study changes in the sorting equilibrium, can then be computed accordingly.

Insert Table 4 here.

4.4 Sorting Before the Experiment

We noted in Proposition 2 that the equilibrium relationship between the proportion of high types $p(N)$ and the duration of the group N depends on the discount factor δ. In particular, there exists a δ^* such that for $\delta < \delta^*$ an increase in N lowers $p(N)$.

The preliminary sorting regression uses data from 1993 only, prior to the policy shock, with a corporate subscriber dummy as the dependent variable. This variable takes on the value of one if the participant is one of the finance companies, zero otherwise. The single regressor is a short duration dummy, which takes on a value of one if the group runs for less than 40 months, zero otherwise.

Table 5, Panel A, begins by partitioning groups into low, medium, and high chit values, and then estimating the sorting regression separately in each aggregate category. Subsequently, Panel B repeats this exercise with an alternative classification of groups by monthly contribution. Short duration groups have a greater proportion of corporate subscribers, without exception, in Panel A and Panel B. Notice also that the coefficient on the short duration dummy grows larger as we move across from Low, to Medium, and particularly to High chit values.

Insert Table 5 here.

Table 5, Panel C, continues with the exercise reported above, reporting regressions for each of the six disaggregate chit values discussed earlier in Table 1 and Table 2 (with the exception of the Rs.15,000 chit value which has no long duration groups). Looking across columns in Panel C we see that the coefficient on the short duration dummy is always positive, and that it is increasing steadily as we move across from low chit values to high chit values.[14]

The negative $p - N$ relationship that we systematically observe in Table 5 is consistent with endogenous matching. To provide additional support for the presence of such endogenous matching, we will subsequently study changes in p over time, at different values of N, following the imposition of the 30% cap on the bids.

4.5 Bids Before and After the Experiment

This section studies the pattern of bids over time in groups with different characteristics (chit values and durations), before and after the policy experiment. The bid in Rupees is divided by the chit value to provide us with a normalized bid amount. What we refer to as the "bid" in all the discussion that follows, is really the normalized bid. This bid value is capped at 0.3 in 1994. The group is divided into five equal time periods, and a dummy is included for each period in the bid regression. Each of these time periods is interacted with a 1994 year-dummy, to capture the change in the pattern of bids over time. The uninteracted Period 1-Period 5 estimates in Table 6 thus describe the pattern of unconstrained 1993 bids, prior to the 30% cap. Separate regressions are estimated for long and short duration groups, within each aggregate chit value.

[14]One outlying group-type - Rs.30,000 chits running for 60 months - is dropped from the regressions reported in Table 5, and later in Table 7 where we study changes in sorting over time. The coefficient on the short duration dummy actually reverses sign in Table 5, Column 3 when the outlying groups are included. Note, however, that the *change* in the sorting that we report in Table 7 is completely unaffected by the inclusion or the omission of these outlying groups.

Insert Table 6 here.

Concentrating on the first five rows of Table 6, Period 1 - Period 5, which describe the unconstrained 1993 bidding pattern, we see that higher bids are generated in the long duration groups (particularly in the early months) in each chit value. This pattern is not at all surprising. The higher bids reflect the fact that the interest rate implicitly faced by borrowers and lenders is compounded over a longer period in the long duration groups. Therefore, even if the implicit annual interest rate is the same in both groups, we would still expect to see higher bids in the initial periods for long duration groups. This point will be made clear in section 5.2, where we analytically derive the implicit interest rate and the difference in initial bids between long and short duration groups.

Looking next across chit values with the same duration, we see that the normalized bids are increasing in the chit value, particularly for the long duration groups. Once again, this pattern is not at all surprising; since the subscribers (particularly the low types) must be compensated for tying up a large amount of capital with the chit fund.

The preceding description of the unconstrained bids tells us what change we would expect to see in 1994. Bids must adjust to the 0.30 cap that was imposed in 1994, and this is exactly what we see in rows 6-10 of Table 6, which describe the change in the bids. Focus on the bold-face coefficients, which highlight bids above 0.3 in 1993 (Rows 1-5) and the corresponding *change* in these bids in 1994 (Rows 6-10). The first point to note is that the change in the bid just brings the 1994 bid down to 0.3 in each case. Within a chit value, the change is always greater in the long duration groups, precisely because the long duration groups have higher initial bids when unconstrained. And controlling for duration, the change is increasing with chit value (especially for the long duration groups).

To help visualize the changes just described, we present nonparametric kernel estimates of the bid regression, separately for low, medium, and high chit values, and separately for short and long duration groups within each chit value, in Figures 2-4. As noted above, groups with higher unconstrained bids in 1993 are capped more severely in 1994. Thus long duration groups are capped more severely than short duration groups, in each chit value. For the same duration, it is easy to see across the Figures that the capping increases with chit value.

Insert Figures 2-4 here.

Looking across Figures 2-4 notice that the 1994 bids always lie below the 1993 bids. Capping the bids leads to an increase in the proportion of high types (from Proposition 4, which we will subsequently verify). And while the 1994 bids in the early periods would certainly have been below the corresponding 1993 levels in capped funds, the 1994 bid schedule could in principle have crossed to the right of the 1993 schedule if the number of high types (bidding at or below the constrained level, 0.3) in the new equilibrium was sufficiently large. But we see instead that the 1994 bids start to

drop below the constrained (0.3) level long before the 1993 bids reach that level in all the Figures.[15]

Notice also that the 1993 and 1994 bids coincide in the later periods in all chit values and durations. The explanation for this observation is very simple. Once the bids fall below the constrained level (0.3) and only low types remain to compete in the auction, then the continuation payoff in a given chit fund must be the same in 1993 and 1994.

4.6 Changes in the Sorting Equilibrium

We now study the change in the proportion of high types p as a consequence of the policy experiment, in groups with different characteristics. The entry effect (Proposition 3) predicts a greater increase in p in the short duration groups following the capping, while the substitution effect (Proposition 4) predicts a greater increase in groups that are capped. We saw in Table 6, and Figures 2-4, that the capping is particularly severe in the long duration groups, although we do see mild capping in the short duration groups with medium and high chit values as well. In general, we would expect p to increase more in the long duration groups if the substitution effect is present.

To study changes in sorting we regress the finance company dummy on the 1994 year dummy in Table 7. Separate regressions are run for each aggregate chit value, and for long and short duration groups within each value. To verify the robustness of the results to alternative partitions of the data, groups are partitioned by chit value (Nv) in Panel A and by the monthly contribution (v) in Panel B. Taking expectations across all subscribers in these regressions, it is easy to verify that the coefficient on the 1994 year dummy measures the change in p from 1993 to 1994.

Insert Table 7 here.

The coefficient on the 1994 dummy is significantly larger for the long duration groups, in each of the three aggregate categories in Table 7, Panel A and Panel B. The proportion of high types in long duration groups increases from 0.18 to 0.24 in the low chit value groups, from 0.13 to 0.19 in the medium chit value groups, and from 0.12 to 0.25 in the high chit value groups. The composition of the chit funds clearly changes dramatically, particularly in the long duration groups, from one year to the next. Since the entry and the substitution effects work in opposite directions, the greater increase in p in the capped long duration groups unambiguously identifies the substitution effect, which tells us in turn that participants match endogenously in this institution.

Intuitively, we would also expect the change in p to be greater in higher categories, holding the duration constant, since the capping is more severe in higher chit values. Once again, this is precisely what we see, although the change in p is not significantly different across successive categories in a

[15] We verified that the same patterns were obtained when we restricted attention to a single monthly duration, instead of the aggregated long and short duration categories, within each chit value. For this exercise we used the most popular monthly duration in each case; 20 months and 50 months for low chit values, 20 months and 40 months for medium chit values, and 25 months and 50 months for high chit values.

couple of cases.[16] Overall, the changes in p that we observe suggest that the sorting equilibrium does respond, as it should, to exogenous changes in the economic environment.

5 Extensions to the Model

We now proceed beyond the model. First, we study changes in the term structure, measured by the proportion of short duration groups, in this institution. Section 5.1 compares the term structure in 1993 and 1994, where we see a substantial increase in the proportion of short duration groups following the capping of the bids. Second, we investigate whether the institution has settled immediately into its new (post-cap) equilibrium. While the analysis in Section 4 provides unambiguous evidence that the institution has drastically changed in the direction predicted by the theory, we cannot tell, by comparing behavior at two points in time, whether the unobservable normalized payoffs W in long and short duration groups have equalized in 1994. We therefore calculate the implicit interest rate of different funds for both years in Section 5.2. We find that while implicit interest rates across different duration funds are roughly equal in 1993, they are not in 1994. The analysis in Section 5.3 confirms that adjustment was not fully completed in 1994. Using aggregate group level data over a longer 1992-2001 period, we find that the basic shift from the pre-cap to the post-cap equilibrium is completed in about two years.

5.1 Term Structure Before and After the Experiment

The empirical results described in the previous section provide strong support for the view that the low types and the high types re-sort themselves following the policy experiment. In the discussion that follows we will study how the term structure in this institution, measured by the proportion of short duration *groups*, responded in turn to the policy experiment.

Continuing with the simple case with two types of groups, of duration $N_1 < N_2$, the consistency condition requires that $p_1 n_1 N_1 + p_2 n_2 N_2 = \mu (n_1 N_i + n_2 N_2)$, where n_1, n_2 denote the measure (number) of funds of each type. Denote $\eta = \frac{n_1}{n_2}$, then

$$\eta = \frac{N_2}{N_1} \frac{\mu - p_2}{p_1 - \mu}.$$

As before we will decompose the impact of the capping into an entry and a substitution effect. Start with the entry effect, which increases μ to μ^E. Prior to the capping, $p_1 > \mu > p_2$ from Proposition 2 and Table 5. Further, $p_1^E - p_1 > p_2^E - p_2$ from Proposition 3. Thus the direct effect of the increase in μ is to increase η, while the indirect effect through the change in p goes in the opposite direction.

Turning to the substitution effect, fixing μ, $p_1^S - p_1 < p_2^S - p_2$, since the long duration groups are capped more severely. With two types of groups, p_1 actually declines while p_2 increases (to preserve

[16] The constant term in Table 7 measures p in 1993 and so matches the point estimates that we presented in Table 5.

the constant μ). If the decline in p_1 is sufficiently large, relative to the increase in p_2, then η could increase as a consequence of the substitution effect. But in general, the effect of changes in p on η, due to the entry and the substitution effects, are ambiguous.

Starting with Table 8, Panel A, we see that the number of individual subscribers (low types) declines substantially across all chit values. While participation by the corporate subscribers (high types) does increase, in the medium and high chit values, this increase never compensates for the decline in participation among the ordinary subscribers. Overall participation declines in all chit values, and the total number of participants declined from 43,267 in 1993 to 34,797 in 1994 (a 20% decline). It is also evident from these statistics that the overall proportion of high types (μ) increases substantially over this period (from 16% to 22%), as expected.

Insert Table 8 here.

Turning to the proportion of short duration groups ($n_1/(n_1+n_2)$) in Panel B, we see that this proportion increases significantly in all chit values. The increase in μ reported in Panel A, which we noted earlier unambiguously leads to an increase in n_1/n_2, presumably dominates any effects of the change in p, which could go in the opposite direction. To verify the robustness of this result, we proceed to disaggregate the group durations in Table 8, Panel C. Starting with durations less than 40 months, in the first three rows, we see an increase in popularity over time, almost without exception. Turning to the long duration groups, in rows 4-7, we see a decline in popularity, once again with almost no exceptions. The increase in the proportion of short duration groups that we observed above in Panel B is driven by underlying changes across all group durations in the data.

5.2 Implicit Interest Rates Before and After the Experiment

While the empirical results presented this far suggest that the chit fund institution is making its way to a new equilibrium, we cannot tell by studying behavior at two points in time whether this change is complete. The equilibrium conditions are derived in terms of the normalized payoff W, which is unobserved by the econometrician. But we can gain a rough sense of whether this institution is in or out of equilibrium by comparing the interest rate that is generated in groups of different types.

There is no explicit price for money - interest rate - in this non-market institution. But based on the actual bids we can still calculate the interest rate implicit in a given chit fund auction. Let $D \equiv \frac{1}{1+r_m} \in [0,1]$ be the monthly interest factor (where r_m is the monthly interest rate) and let c_t denote the funds received in period t. The participant contributes an amount v each month over a period of N months (the duration of the group). Hence, the budget constraint for any participant must satisfy the condition

$$\sum_{t=1}^{N} D^{t-1}(c_t - v) = 0. \tag{7}$$

The net present value of monthly contributions must equal the net present value of funds received. The inflow of funds in any period t in which a participant does not win the auction is given by $c_t = \frac{1}{N} b_t$: she gets her equal share of the bid. In one period, say τ, the participant wins the chit fund, in which case she collects $c_\tau = Nv - b_\tau + \frac{1}{N} b_\tau$, i.e. the total pot minus her bid $Nv - b_\tau$ in addition to her share of the bid. We can now rewrite the budget constraint in equation (7) for a participant who wins the auction in period τ as:

$$D^{\tau-1}(Nv - b_\tau) + \sum_{t=1}^{N} D^{t-1}\left(\frac{1}{N} b_t - v\right) = 0.$$

It follows immediately from this expression that the budget constraints of different agents only differ in the first term. Therefore, we can calculate the interest factor D from any two agents' budget constraints, i.e. agents who win the bids in two different periods τ and τ' as

$$D = \left(\frac{Nv - b_\tau}{Nv - b_{\tau'}}\right)^{\frac{1}{\tau' - \tau}}.$$

Using the relationship between D and the monthly interest rate r_m provided earlier, and converting r_m to the corresponding annual rate, we obtain:

$$r = \left(\frac{Nv - b_{\tau'}}{Nv - b_\tau}\right)^{\frac{12}{\tau' - \tau}} - 1. \tag{8}$$

In practice we compute the annual interest rate using the winning bid in the second period ($\tau = 2$) and the last period ($\tau' = N$) in each group.[17] These interest rates are reported separately by chit value, duration, and year in Table 9.

Insert Table 9 here

The 1989 Report on *Urban Informal Credit Markets in India* (Dasgupta 1989) tells us that the interest rate paid by non-banking finance companies, which include chit funds, was 18%. The unconstrained interest rates that we compute for 1993 match very well with this statistic, ranging from 14% to 24%. The same Report tells us that the interest rate paid by nationalized banks on term deposits was 9%, so the popularity of the chit funds is easy to understand.

Subsequently the capping brought the interest rates down dramatically, and they range from 8% to 17% in 1994, which is much closer to the bank rate. The sharp decline in participation by the individual subscribers that we saw in Table 8, Panel A, is once more easy to understand.

[17] Recall from the discussion in Section 2 that the chit fund organizer collects the first pot without bidding, $b_1 = 0$, and so competitive bidding only commences in period 2. The individual who wins in the second period can thus be treated as a pure borrower, while the individual who wins in the last period is a pure lender.

Notice also, from Table 9, that interest rates for short and long duration groups within a given chit value are roughly comparable.[18] In contrast, we see that the interest rates on the long duration groups are significantly lower than the corresponding rates in the short duration groups, within the same chit value, in 1994.

Finally, Table 9 and the calculation of the implicit interest rate can now also clarify why the initial bids in the long duration chit funds are higher than the initial bids in the short duration funds. Consider any two funds of duration N_1 and N_2 with $N_1 < N_2$. Define the first competitive bid, normalized by the chit value (as plotted in Figures 2-4) as $\beta(N) = \frac{b_2}{Nv}$. Recall that the last period's bid is zero: $b_N = 0$. Then, from equation (8), we get

$$\begin{aligned} r &= \left(\frac{Nv}{Nv(1-\beta(N))}\right)^{\frac{12}{N-2}} - 1 \\ &= (1-\beta(N))^{-\frac{12}{N-2}} - 1. \end{aligned}$$

Since rates in funds N_1 and N_2 are roughly equal in 1993, from Table 9, it follows that

$$(1-\beta(N_1))^{-\frac{12}{N_1-2}} = (1-\beta(N_2))^{-\frac{12}{N_2-2}}.$$

Taking logs and collecting terms,

$$\frac{\ln(1-\beta(N_2))}{\ln(1-\beta(N_1))} = \frac{N_2-2}{N_1-2}.$$

Since $\beta(N) \in [0,1]$ and $N_1 < N_2$, this implies that $\beta(N_2) > \beta(N_1)$.[19]

5.3 Long Term Changes in the Term Structure

While we cannot map the computed interest rates directly into normalized payoffs W, the wide discrepancy in these interest rates in 1994, for long and short duration groups within the same chit

[18]The short duration groups tend to generate a slightly higher interest rate, but this is most likely because our computation assumes a constant interest factor D (an hence r) in each period of time. In reality, there are two reasons why this is unlikely to be the case. The first is that one would expect the interest rate to differ depending on the interest rate term structure. Second, the implied markets are clearly not perfect and without frictions. In particular, we ignore the "tax" that is imposed on the participants by virtue of the fact that the chit fund organizer wins the first auction without competitive bidding (this is a legally stipulated feature of the institution). By setting the discount factor D to be the same in each period, we are implicitly assuming that there are no such frictions within the group. But once we introduce the tax, then the discount factor will vary over time, and the familiar spread between the borrowing and the lending interest rates will emerge. The interest rates that we report in Table 9 thus lie somewhere within this spread. Each participant in a short duration group must bear a greater tax burden, for a given chit value, which implies that the spread will be greater in those groups. The actual lending rate in short duration groups could then equal or even lie below the corresponding rate in the long duration groups.

[19]Consider a hypothetical example with $N_1 = 20$ and $N_2 = 30$ and suppose that $\beta(20) = 0.20$, then it is immediately verified that $\beta(30) = 0.29$. Long duration funds have higher initial bids because they reflect the fact that interest rates are compounded over longer periods.

value, suggests very strongly that the chit fund institution is yet to reach the post-cap equilibrium. Additional support for this view can also be obtained from Figure 2, which describes the bid pattern for the low chit value groups. The bid schedule for the short duration groups is essentially the same in 1993 and 1994. In contrast, the 1994 bids are substantially lower than the 1993 bids for the long duration groups in that Figure. Participants who were indifferent between the long and short duration low chit value groups in 1993 evidently would not remain that way in 1994. While the proportion of high types might have adjusted in the right direction to move the institution to the new equilibrium, this institutional change does not appear to have been completed by 1994.

We conclude the empirical analysis by using aggregate group level data to study the change in the composition of groups over a ten-year period 1992-2001. The proportion of short duration groups that commenced in each year over this period is computed, separately for low, medium, and high chit values. These proportions are plotted, without smoothing, in Figure 5.

Insert Figure 5 here.

The proportion of short duration groups increases sharply from 1993 to 1994, for low, medium, and high chit values, just as we saw in Table 8. But this increase continues for one more year, 1994-95, consistent with the discussion above, after which the proportion of short duration groups flattens out. The proportion of short duration groups in low and high chit values increases from about 0.2 in 1993 to over 0.4 by 1995. The medium chit values begin with a much higher proportion of short duration groups, above 0.5 in 1993, yet this proportion increases even further to 0.7 by 1995. The term structure in this institution clearly responds quite dramatically to the change in the economic environment.

There seems to be some overshooting in 1995, and some shaking out thereafter, judging from the minor oscillations in the Figure, but the basic shift from the pre-cap to the post-cap equilibrium is completed in two years. The institutional response to this exogenous shock is extremely rapid, given that this is a decentralized equilibrium. A fresh set of individuals joins the chit fund each period, which makes the rapid response in this non-market institution even more remarkable.

6 Conclusion

The results in this paper provide strong support for the view that the particular non-market institution that we study - the chit fund - responds swiftly and appropriately to an exogenous change in the economic environment. The theory predicts that groups in which bids are capped more severely will be associated with a larger increase in the proportion of high types (p) following the policy experiment. This proportion does increase more sharply in long duration groups (and in higher chit values) providing striking endorsement for the view that participants in the chit fund are matching endogenously.

An alternative explanation for the observed changes is that the composition of the participants changed as a consequence of the bid-ceiling, or that other unobserved exogenous changes in the economic environment are responsible for what we see. We have already verified in Table 3 that the income distribution of the individual subscribers, within aggregate chit values, is very stable over time. It is also not obvious how these alternative arguments would explain the precise change in p that we observe, along both the duration and the chit value dimension, in the data.

We have seen that the participants in the chit funds responded immediately to the policy shock by re-sorting themselves. The endogenous institutional view that we take in this paper would predict that the *structure* of the institution itself should also respond to the policy shock. And indeed we see that the term structure, measured by the proportion of short duration groups, does respond quite dramatically to the change in the economic environment. Further, while the Chit Fund Act specifies that the winning bid should be distributed among the members of the group, it does not stipulate that the bid should be distributed *equally* among them; this is just a convention that has been adopted historically by the chit fund companies. Starting from October 2000, Shriram Chits introduced the Extra Dividend Scheme (EDS), in all groups with durations 40 months or longer, in which those subscribers who won the auction in the initial months received only one percent of the normal dividend thereafter, for the duration of the group.[20] This effectively increases the amount that these early winners pay out, moving the interest rates in the long duration groups closer to their unconstrained levels.

Such changes in the rules of the game are difficult to implement, and the Company experimented with numerous alternative schemes, in a limited number of groups, before it settled on the EDS scheme described above. It is nevertheless very encouraging to see the very structure of the institution change, in response to an exogenous change in the economic environment, within a relatively short period of seven years.

It is not obvious that capping the bids generated any efficiency gains in this institution. Default rates were low to begin with, and continued to remain that way after the policy experiment. Interest rates moved down even further from the competitive level, and while the banks may have picked up some of the (potential) subscribers who stopped participating, there was most likely a substantial decline in the overall volume of capital entering the system. The participants in the chit funds did respond to the policy shock by re-sorting themselves, and the company did respond by altering the structure of the institution, but these are only second-best responses. Government intervention in this case most likely exacerbated the inefficiencies that were already present in the financial system.

[20] This restriction on the dividend applies to those subscribers who win the auction in the first 10 months for groups of 40 months duration, and the first 20 months for groups of longer duration.

7 Appendix

Proposition 1. *For all* $t < N$

$$\Delta V_1(N,p) = \delta^{pN-1}\Delta V_N$$

and $\triangle V_N(N,p) = Nv\left[\overline{\gamma} - \underline{\gamma}\right] = Nv \triangle \gamma$.

Proof. While V_t is the expected continuation payoff, denote the expected continuation payoff after realization of the private signal σ_t as v_t.

There are pN high types in the group, so first consider periods in which more than one high type remains among the bidders, $t = 1, ..., pN-1$. The payoff to the high type with signal σ_t^i can then be written as

$$\overline{v}_t = \Pr\left\{\overline{b}_t^i > \max\left\{\overline{b}_t^{-i}\right\}\right\}\left(\overline{V}_N + \sigma_t^i - \overline{b}_t^i\right) + \left(1 - \Pr\left\{b_t^i > \max\left\{\overline{b}_t^{-i}\right\}\right\}\right)\left(\delta\overline{V}_{t+1} + \frac{1}{N-t}\max\left\{\overline{b}_t^{-i}\right\}\right).$$

Consider a (type-contingent) symmetric bidding function $\overline{b}_t^i = \frac{N-t}{N-t+1}\left(\overline{V}_N - \delta\overline{V}_{t+1}\right) + \overline{f}(\sigma_t^i)$ and $\underline{b}_t^i = \frac{N-t}{N-t+1}\left(\underline{V}_N - \delta\underline{V}_{t+1}\right) + \underline{f}(\sigma_t^i)$ (where $f(\sigma_t^i)$ is an increasing function that approaches 0 as ε – the bound of the symmetric support of σ_t – goes to zero).

We are interested in the case where ε goes to zero, so we verify whether for $\varepsilon = 0$, bidding $\overline{b}_t = \frac{N-t}{N-t+1}\left(\overline{V}_N - \delta\overline{V}_{t+1}\right)$ is an equilibrium strategy. The expected payoff V_t (which is equal to v_t when $\varepsilon = 0$) is

$$\begin{aligned}
\overline{V}_t &= \Pr\left\{\overline{b}_t^i > \max\left\{\overline{b}_t^{-i}\right\}\right\}\left(\overline{V}_N - \frac{N-t}{N-t+1}\left(\overline{V}_N - \delta\overline{V}_{t+1}\right)\right) \\
&\quad + \left(1 - \Pr\left\{b_t^i > \max\left\{\overline{b}_t^{-i}\right\}\right\}\right)\left(\delta\overline{V}_{t+1} + \frac{1}{N-t}\frac{N-t}{N-t+1}\left(\overline{V}_N - \delta\overline{V}_{t+1}\right)\right) \\
&= \frac{1}{pN-t+1}\left(\frac{1}{N-t+1}\left(\overline{V}_N + (N-t)\,\delta\overline{V}_{t+1}\right)\right) \\
&\quad + \left(1 - \frac{1}{pN-t+1}\right)\left(\frac{1}{N-t+1}\left(\overline{V}_N + (N-t)\,\delta\overline{V}_{t+1}\right)\right) \\
&= \frac{1}{N-t+1}\left(\overline{V}_N + (N-t)\,\delta\overline{V}_{t+1}\right)
\end{aligned}$$

where $\Pr\left\{\overline{b}_t^i > \max\left\{\overline{b}_t^{-i}\right\}\right\} = \frac{1}{pN-t+1}$. Note that there is no incentive to deviate either way. Overbidding – say $\overline{b}_t^i + d$ – implies winning the auction with certainty; however the expected utility is strictly lower: $\overline{V}_N - \frac{N-t}{N-t+1}\left(\overline{V}_N - \delta\overline{V}_{t+1}\right) - d < \frac{1}{N-t+1}\left(\overline{V}_N + (N-t)\,\delta\overline{V}_{t+1}\right)$, and underbidding is weakly dominated. It is easy to verify that this bidding strategy leaves the high types indifferent between winning and losing the current auction: $\overline{V}_t = \overline{V}_N - \overline{b}_t = \delta\overline{V}_{t+1} + \frac{1}{N-t}\overline{b}_t$.

Similarly, there is no incentive to deviate for the low type, whose payoff is

$$\begin{aligned}
\underline{V}_t &= \delta\underline{V}_{t+1} + \frac{1}{N-t}\overline{b}_t \\
&= \delta\underline{V}_{t+1} + \frac{1}{N-t+1}\left(\underline{V}_N - \delta\underline{V}_{t+1}\right).
\end{aligned}$$

Now calculating $\Delta V_t = \overline{V}_t - \underline{V}_t$ is straightforward: $\Delta V_t = \delta \Delta V_{t+1}$. Solving recursively, $\Delta V_1 = \delta^{pN-1} \Delta V_{pN}$.

In period $t = pN$, only one high type is left. Now the auction is a high bid auction with a distribution shift (see Maskin and Riley (2000, proposition 4.3). Consider the following bids as derived in Maskin and Riley (2000): $\overline{b}_{pN} = \frac{N-pN}{N-pN+1} \left(\underline{V}_N - \delta \underline{V}_{pN+1} \right) + \varepsilon$ and $\underline{b}_{pN} = \frac{N-pN}{N-pN+1} \left(\underline{V}_N - \delta \underline{V}_{pN+1} \right) + \underline{\sigma}_{pN} \leq \overline{b}_{pN}$. The low type will never bid higher than the high type (only if the low type gets the highest draw $\underline{\sigma}_{pN} = \varepsilon$ will she have the same bid). As a result, the high type always wins the auction for sure at the lowest price possible. She has no incentive to deviate provided ε is sufficiently small. The low type has no incentive to deviate either. Bidding lower is weakly dominated, while bidding higher than $\overline{b}_{pN}$ implies a payoff

$$\begin{aligned} \underline{v}_{pN} &= \underline{V}_N + \underline{\sigma}_t^i - \overline{b}_{pN} \\ &= \frac{1}{N - pN + 1} \left[\underline{V}_N + (N - pN) \, \delta \underline{V}_{pN+1} \right] + \underline{\sigma}_t^i - \varepsilon. \end{aligned}$$

On the other hand, bidding the equilibrium bid $\underline{b}_1$ assures a payoff

$$\begin{aligned} \underline{v}_{pN} &= \delta \underline{V}_{pN+1} + \frac{1}{N - pN} \overline{b}_{pN} \\ &= \frac{1}{N - pN + 1} \left[\underline{V}_N - (N - pN) \, \delta \underline{V}_{pN+1} \right] + \frac{1}{N - pN} \varepsilon. \end{aligned}$$

Since $\underline{\sigma}_t^i \leq \varepsilon$ and $\varepsilon > 0$, there is no incentive to deviate. Now for ε (and as a result σ) approaching zero, $\overline{b}_{pN}$ approaches $\underline{b}_{pN}$. As a result, the payoffs v_{pN} are equal to V_{pN} (i.e. the expected payoff). It is easy to verify that this bidding strategy leaves the low type indifferent between winning and losing the current auction, giving us

$$\begin{aligned} \overline{V}_{pN} &= \overline{V}_N - \overline{b}_{pN} \\ \underline{V}_{pN} &= \delta \underline{V}_{pN+1} + \frac{1}{N - pN} \overline{b}_{pN} = \underline{V}_N - \overline{b}_{pN}. \end{aligned}$$

As a result, $\Delta V_{pN} = \Delta V_N$. From the fact that $\Delta V_1 = \delta^{pN-1} \Delta V_{pN}$, it now follows that $\Delta V_1 = \delta^{pN-1} \Delta V_N = \delta^{pN-1} N \Delta \gamma$.

Note that for any subsequent period $t = pN+1, ..., N$, the bids (for $\varepsilon = 0$) are $\underline{b}_t = \frac{N-t}{N-t+1} \left(\underline{V}_N - \delta \underline{V}_{t+1} \right)$ – all the high types have already won and no longer bid – and as a result

$$\begin{aligned} \underline{V}_t &= \delta \underline{V}_{t+1} + \frac{1}{N - t} \underline{b}_t = \underline{V}_N - \underline{b}_t \\ &= \frac{1}{N - t + 1} \left(\underline{V}_N + (N - t) \, \delta \underline{V}_{t+1} \right) \end{aligned}$$

■

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Figure 1: Choice of Chit Value

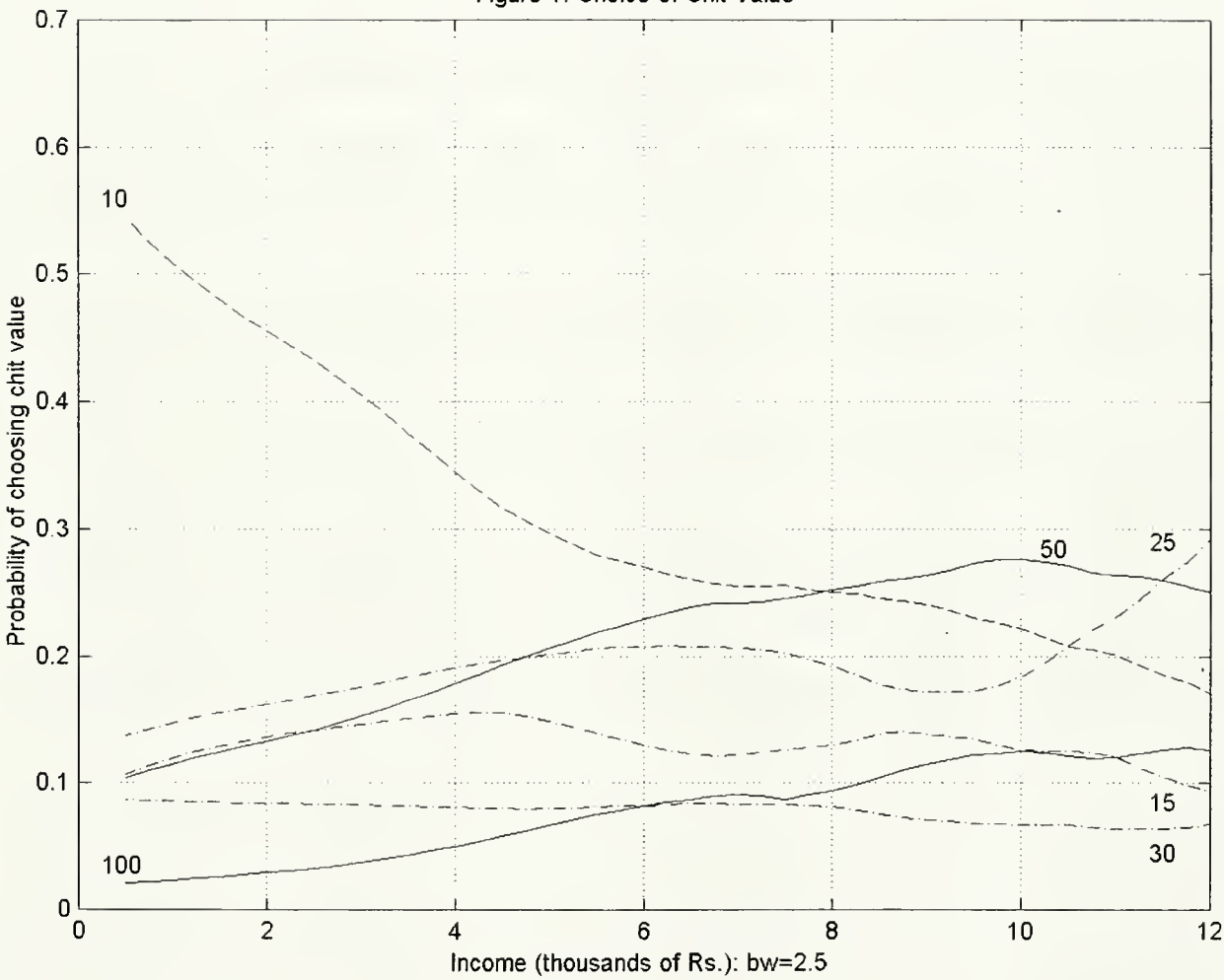

Figure 2: Bids - Low Chit Values

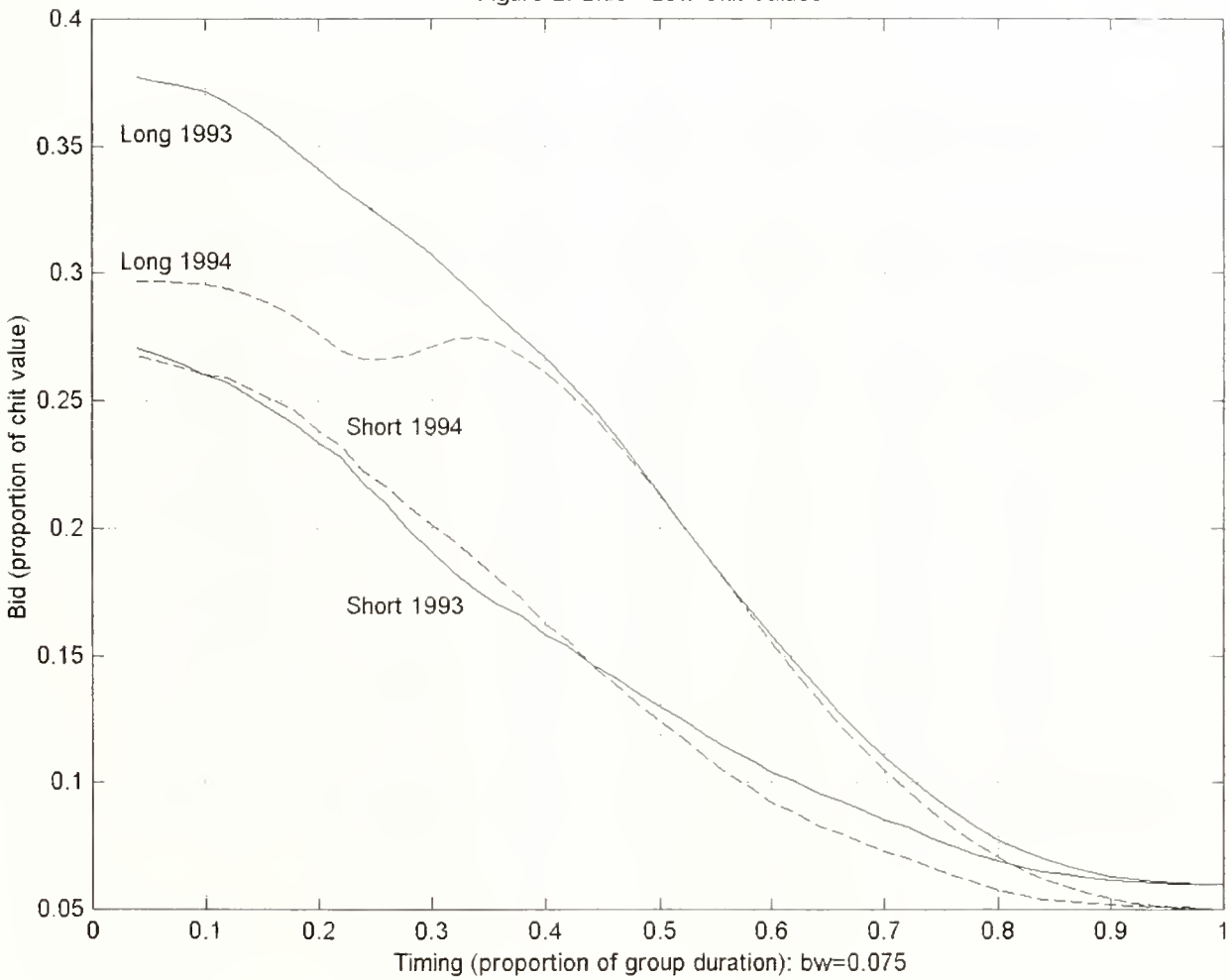

Figure 3: Bids - Medium Chit Values

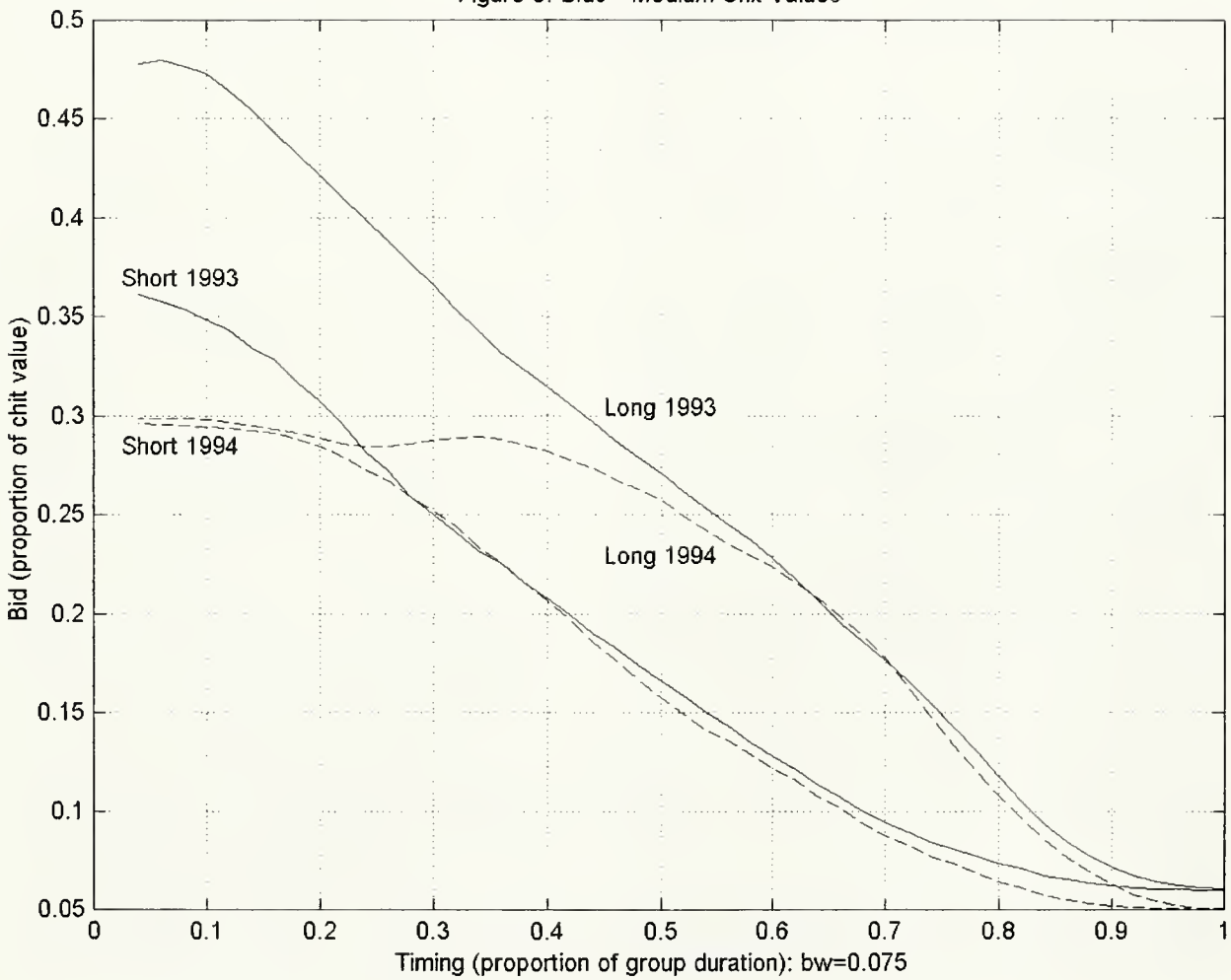

Figure 4: Bids - High Chit Values

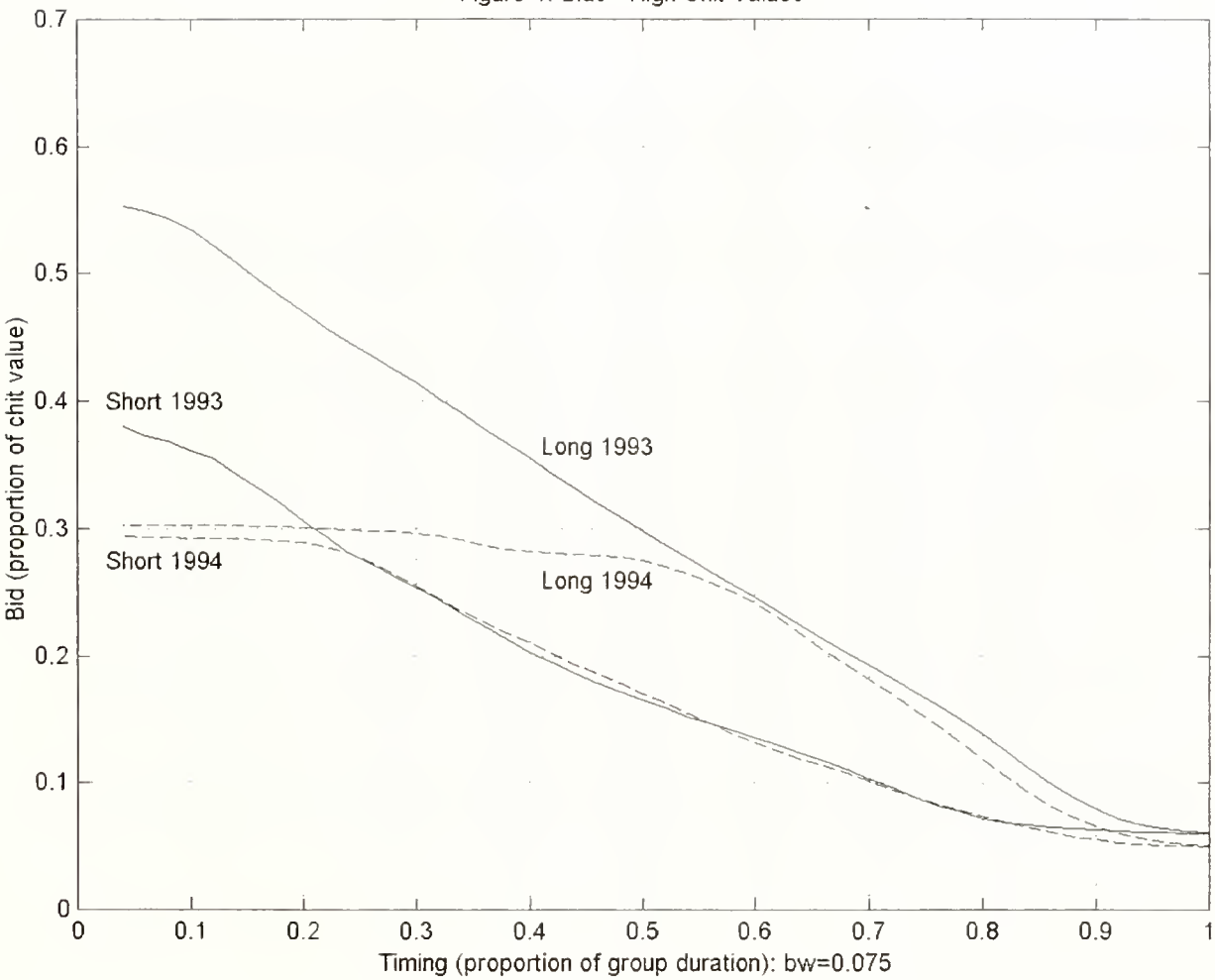

Figure 5: Proportion of Short Duration Groups

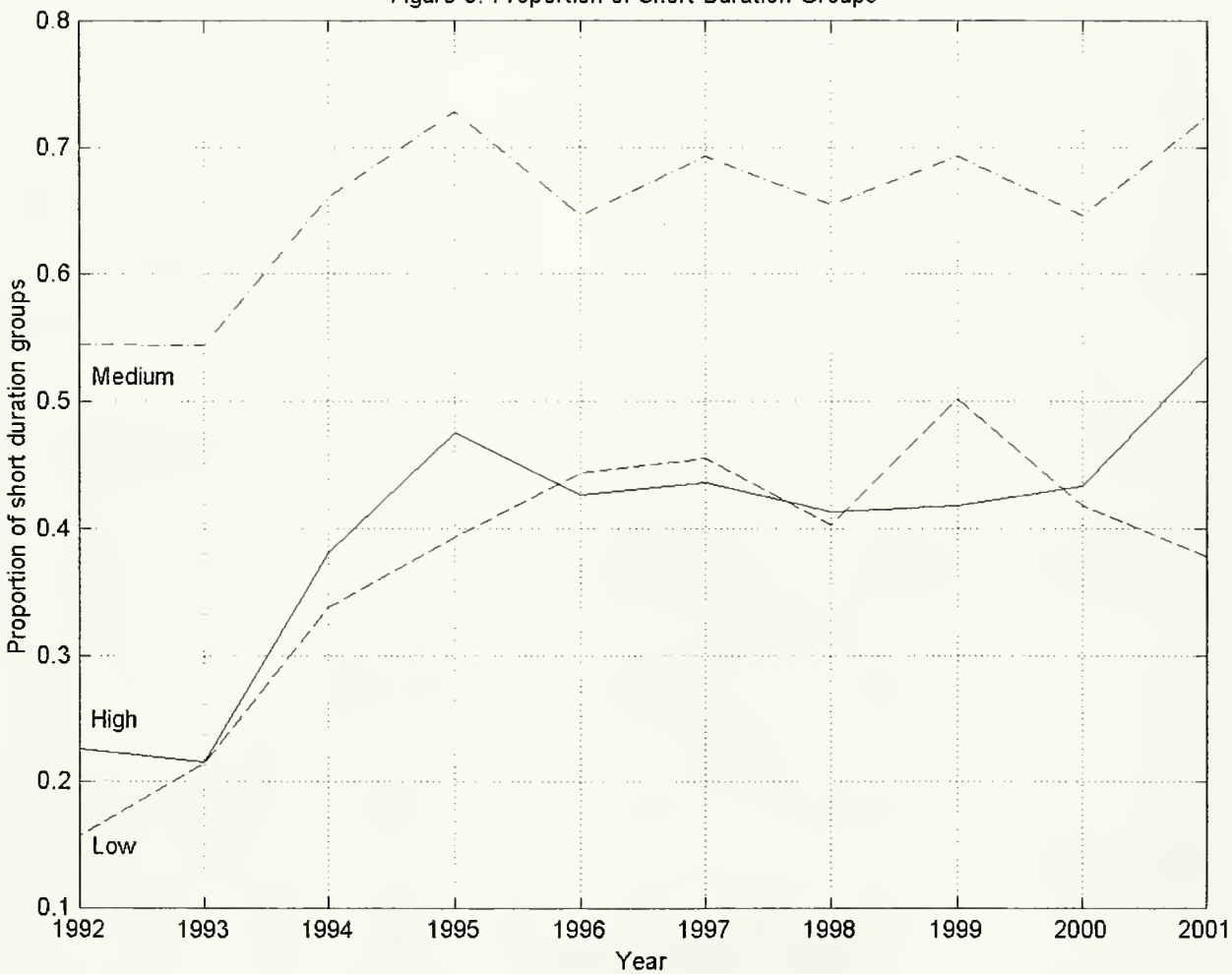

Table 1: Chit Value-Income Relationship

Dependent variable:	chit value					
Chit value (thousands of Rs.):	10	15	25	30	50	100
	(1)	(2)	(3)	(4)	(5)	(6)
A. Multinomial logit model						
Income	-0.156	0.009	0.030	--	0.058	0.071
	(0.010)	(0.012)	(0.009)		(0.008)	(0.009)
Constant	1.574	-0.528	0.147	--	-0.040	-1.345
	(0.041)	(0.051)	(0.041)		(0.040)	(0.050)
B. Linear probability model						
Income	-0.003	-0.0001	0.00006	-0.0003	0.001	0.003
	(0.0003)	(0.0002)	(0.0003)	(0.0002)	(0.0003)	(0.0001)
Constant	0.409	0.083	0.175	0.137	0.158	0.038
	(0.004)	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)

Note: chit value is the product of the monthly contribution and the duration.
Chit value and income are measured in thousands of Rs.
Multinomial logit model is estimated with chit value=30 as the base value.
Linear probability model is estimated independently for each chit value.
Number of observations in all regressions is 20,885.
Standard errors in parentheses.

Table 2: Group Level Descriptive Statistics

Chit value (thousands of Rs.):		Breakdown of total groups in each chit value (%)					
		10	15	25	30	50	100
		(1)	(2)	(3)	(4)	(5)	(6)
Duration		LOW		MEDIUM		HIGH	
20 months		17.75	3.41	1.72	4.42	3.59	11.30
25 months	SHORT	8.40	--	25.77	--	23.08	10.43
30 months		--	96.59	--	30.94	--	11.30
40 months		73.56	--	71.82	5.52	12.31	41.74
50 months	LONG	0.28	--	0.69	--	61.03	13.91
60 months		--	--	--	59.12	--	1.74
100 months		--	--	--	--	--	9.57
Total		100.00	100.00	100.00	100.00	100.00	100.00
Total number of groups		1059	381	291	181	195	115

Note: Chit value is the product of the monthly contribution and the the number of participants in the group.
Number of participants is equal to the duration of the group in months.
Groups are divided into three aggregate chit values (low, medium, high) and two aggregate durations (short, long).

Table 3: Individual Level Descriptive Statistics

Chit value:	Low		Medium		High	
Year:	1993	1994	1993	1994	1993	1994
	(1)	(2)	(3)	(4)	(5)	(6)
A. Income Distribution (individual subscribers)						
Mean	2.90	2.98	3.66	3.66	4.84	7.59
(standard deviation)	(2.70)	(3.06)	(4.79)	(3.00)	(9.12)	(35.94)
0.01 quantile	0.65	0.65	0.90	0.90	1.00	1.00
0.05 quantile	1.00	1.00	1.25	1.19	1.50	1.50
0.10 quantile	1.14	1.12	1.52	1.55	1.86	1.94
0.25 quantile	1.63	1.70	2.23	2.24	2.58	2.71
0.50 quantile	2.47	2.50	3.00	3.03	3.55	3.83
0.75 quantile	3.50	3.50	4.10	4.33	5.00	5.25
0.90 quantile	4.90	5.00	5.79	6.00	7.35	8.00
0.95 quantile	5.99	6.25	7.48	7.40	10.00	10.00
0.99 quantile	9.24	10.00	12.45	12.50	33.33	60.00
B. Proportion of corporate subscribers						
	0.17	0.23	0.15	0.20	0.12	0.24

Note: Income is measured in thousands of Rs.
Aggregate chit value: Low if chit value=10000, Medium if 10000<chit value<50000, High if chit value>=50000.

Table 4: Timing of Winning Bids

Dependent variable:	Timing					
Chit value:	Low		Medium		High	
Year:	1993	1994	1993	1994	1993	1994
	(1)	(2)	(3)	(4)	(5)	(6)
Corporate subscriber	-0.124	-0.124	-0.105	-0.144	-0.151	-0.118
	(0.005)	(0.006)	(0.007)	(0.006)	(0.010)	(0.008)
Constant	0.535	0.543	0.530	0.543	0.529	0.541
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Number of observations	21,400	14,635	14,300	13,411	7,555	6,750

Note: Timing is measured as the winning month divided by the total duration of the group.
Chit value: Low if chit value=10000, Medium if 10000<chit value<50000, High if chit value>=50000.
Corporate subscriber equals one if finance company, zero otherwise.
Standard errors in parentheses.

Table 5: Preliminary Sorting Regressions (1993)

Dependent variable:	Corporate subscriber				
	(1)	(2)	(3)	(4)	(5)
A. Coarse Partition of chit value (Nv)	Low		Medium		High
Short duration	0.012		0.016		0.095
	(0.008)		(0.007)		(0.012)
Constant	0.177		0.130		0.115
	(0.003)		(0.005)		(0.004)
Number of observations	20,806		10,723		7,394
B. Coarse partition of contribution (v)	Low		Medium		High
Short duration	0.022		0.023		0.061
	(0.012)		(0.007)		(0.008)
Constant	0.176		0.129		0.115
	(0.003)		(0.005)		(0.004)
Number of observations	19,398		10,727		8,798
C. Fine partition of chit value (Nv)	10,000	25,000	30,000	50,000	100,000
Short duration dummy	0.009	0.034	0.056	0.085	0.150
	(0.008)	(0.013)	(0.026)	(0.015)	(0.026)
Constant	0.180	0.130	0.090	0.087	0.149
	(0.003)	(0.006)	(0.022)	(0.005)	(0.009)
Number of observations	17725	4696	784	3683	2063

Note: Chit value and Contribution is measured in Rs.
Chit value: Low if chit value=10000, Medium if chit value 10000-50000, High if chit value>=50000.
Contribution: Low if contribution<500/month, Medium if contribution 500-1000, High if contribution>1000.
Corporate subscriber equals one if finance company, zero otherwise.
Short duration equals one if the group is of less than 40 months duration.
Regressions use 1993 data only.
Standard errors in parentheses.

Table 6: Bid Regressions

Dependent variable:	Bid					
Chit value:	Low		Medium		High	
Duration:	Short	Long	Short	Long	Short	Long
	(1)	(2)	(3)	(4)	(5)	(6)
Period 1	0.258	**0.368**	**0.345**	**0.466**	**0.357**	**0.527**
	(0.002)	(0.001)	(0.002)	(0.002)	(0.004)	(0.002)
Period 2	0.202	0.310	0.262	**0.371**	0.263	**0.418**
	(0.002)	(0.001)	(0.001)	(0.002)	(0.003)	(0.002)
Period 3	0.137	0.220	0.173	0.275	0.173	0.304
	(0.002)	(0.001)	(0.001)	(0.002)	(0.003)	(0.002)
Period 4	0.090	0.117	0.101	0.181	0.110	0.197
	(0.002)	(0.001)	(0.001)	(0.002)	(0.003)	(0.002)
Period 5	0.062	0.065	0.064	0.076	0.064	0.085
	(0.002)	(0.001)	(0.001)	(0.002)	(0.003)	(0.002)
Period 1 * 1994 dummy	0.002	**-0.074**	**-0.051**	**-0.169**	**-0.064**	**-0.224**
	(0.003)	(0.001)	(0.002)	(0.003)	(0.005)	(0.003)
Period 2 * 1994 dummy	0.008	-0.039	-0.004	**-0.084**	-0.001	**-0.123**
	(0.003)	(0.001)	(0.002)	(0.003)	(0.004)	(0.003)
Period 3 * 1994 dummy	-0.003	-0.001	-0.006	-0.017	0.005	-0.031
	(0.003)	(0.001)	(0.002)	(0.003)	(0.004)	(0.003)
Period 4 * 1994 dummy	-0.013	-0.005	-0.006	-0.002	-0.003	-0.009
	(0.003)	(0.001)	(0.002)	(0.003)	(0.004)	(0.003)
Period 5 * 1994 dummy	-0.010	-0.009	-0.010	-0.009	-0.006	-0.014
	(0.002)	(0.001)	(0.002)	(0.002)	(0.004)	(0.003)
Number of observations	5470	29543	13204	13732	2286	11697

Note: Bid is measured as the bid amount divided by the chit value.
Chit value: Low if chit value=10000, Medium if chit value 10000-50000, High if chit value>=50000.
Short duration groups last for less than 40 months, Long duration groups last for 40 months or more.
Each group is divided into 5 equal periods: Period 1- Period 5, covering its entire duration in sequence.
Bold face coefficients highlight bids greater than 0.3 in Rows 1-5 and the change in those bids in Rows 6-10.
Standard errors in parentheses.

Table 7: Sorting Regressions (1993 versus 1994)

Dependent variable:	Corporate subscriber					
Chit value/Contribution:	Low		Medium		High	
Duration:	Short	Long	Short	Long	Short	Long
	(1)	(2)	(3)	(4)	(5)	(6)
A. Partition by chit value (Nv)						
1994 dummy	0.004	0.066	0.030	0.063	0.045	0.133
	(0.011)	(0.005)	(0.006)	(0.008)	(0.019)	(0.007)
Constant	0.189	0.177	0.145	0.130	0.210	0.115
	(0.008)	(0.003)	(0.005)	(0.005)	(0.015)	(0.005)
Number of observations	5,470	29,543	13,204	7,832	2,280	11,697
B. Partition by contribution (v)						
1994 dummy	-0.010	0.066	0.023	0.063	0.044	0.133
	(0.017)	(0.005)	(0.006)	(0.008)	(0.011)	(0.007)
Constant	0.198	0.176	0.152	0.129	0.176	0.115
	(0.012)	(0.003)	(0.005)	(0.006)	(0.009)	(0.005)
Number of observations	2,088	29,788	13,344	7,587	5,522	11,697

Note: Corporate subscriber equals one if finance company, zero otherwise.
Chit value: Low if chit value=10000, Medium if chit value 10000-50000, High if chit value>=50000.
Contribution: Low if contribution<500/month, Medium if contribution 500-1000, High if contribution>1000.
Short duration groups last for less than 40 months, Long duration groups last for 40 months or more.
Standard errors in parentheses.

Table 8: Change in Term Structure and Participation

Chit value:		Low		Medium		High	
Year:		1993	1994	1993	1994	1993	1994
		(1)	(2)	(3)	(4)	(5)	(6)
Panel A : Subscriber participation							
Private subscribers		17,688	11,331	12,133	10,772	6,637	5,108
Corporate subscribers		3,713	3,304	2,167	2,639	929	1,643
Panel B : Proportion of short duration groups							
		0.217	0.318	0.573	0.656	0.217	0.359
		(0.017)	(0.023)	(0.025)	(0.024)	(0.033)	(0.037)
Panel C : Distribution of group durations (%)							
Duration:							
20 months		14.65	21.26	2.05	4.69	6.83	4.79
25 months	SHORT	7.07	10.51	8.70	8.85	11.80	22.75
30 months		--	--	46.55	52.08	3.11	8.38
40 months		78.11	67.99	27.11	22.40	16.77	20.96
50 months	LONG	0.17	0.23	1.79	--	44.10	32.34
60 months		--	--	13.81	11.98	11.18	10.18
100 months		--	--	--	--	6.21	0.60
Total		100	100	100	100	100	100

Note: Chit value: Low if chit value=10000, Medium if chit value 10000-50000, High if chit value>=50000.
Short duration groups last for less than 40 months, Long duration groups last for 40 months or more.
Panel A reports number of participants in each chit value in each year.
Panel B measures proportion of short duration groups in each chit value in each year using group level data.
Proportion of short duration groups in 1994 is significantly higher, at the 5 percent level, for all values.
Panel C reports distribution of group durations in each chit value in each year (measured as percentage of all groups).
Standard errors in parentheses.

Table 9: Implicit Interest Rates

Chit value:	Low		Medium		High	
Duration:	Short	Long	Short	Long	Short	Long
	(1)	(2)	(3)	(4)	(5)	(6)
Interest rate (%)						
1993	16.48	14.15	18.92	18.17	24.18	20.88
	(0.36)	(0.12)	(0.32)	(0.63)	(1.02)	(0.56)
1994	17.00	9.95	14.52	8.77	16.58	8.38
	(0.42)	(0.04)	(0.15)	(0.16)	(0.37)	(0.13)

Note: Short duration groups last for less than 40 months, Long duration groups last for 40 months or more.
Chit value: Low if chit value=10000, Medium if chit value 10000-50000, High if chit value>=50000.
Mean interest rate (in percentage) with standard errors in parentheses.
Interest rates are computed at the group level.
All means for short and long duration are different at the 5% significance level except Columns 3-4 (1993).